DAIRY DAY 1984

Report of Progress 460, October, 1984
Agricultural Experiment Station, Kansas State University, Manhattan
John O. Dunbar, Director

FOREWARD

Members of the Dairy Commodity Group of the Department of Animal Sciences and Industry are pleased to present the Report of Progress, 1984. Dairying continues to be a viable business and contributes significantly to the total agricultural economy of Kansas. At the year's beginning, 2,381 farms in Kansas were marketing milk with 1,494 in the Grade A phase. Estimates indicated that the 118,00 dairy cows generated $185 million in farm value of milk with another $52 million attributable to meat-bull calves, steers, and cull cows. Wide variation exists in productivity per cow as indicated by the production testing program (DHIA). About one-half of the state's dairy herds are enrolled in the DHIA program, and tested cows average 55% more income-over-feed costs compared to non-tested cows. Obviously, much emphasis should be placed on furthering the DHIA program.

Of special note in this report is the summary of the herd expansion program that was started in 1978. An addition of 72 heifers, valued at $51,500, and a few monetary donations enabled the new dairy center to reach its optimal capacity of 200+ milking cows. The herd expansion has enabled researchers to add additional observations to their experiments while making the herd more efficient, management-wise. As has been demonstrated, each dollar spent for organized research yields 30 to 50 percent return in practical application. Research is not only tedious and painstakingly slow but expensive. Interested parties are encouraged to consider participation in the Livestock and Meat Industry Council (LMIC) - a philanthropic organization dedicated to furthering academic and research pursuits by the Department. More detailed information about LMIC is contained in this publication. Lastly, appreciation is expressed to the College of Veterinary Medicine for their continued support and cooperation. In recent years, an excellent relationship has been established to the mutual benefit of all parties in developing cooperative research and establishing an exemplary herd health program.

E.P. Call, Editor
1984 Report of Progress

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SUMMARY

THE HERD EXPANSION PROGRAM

E.P. Call and M.K. Schmidt

Kansas dairy producers were solicited in 1978 to procure a number of heifers to enlarge the Dairy Teaching and Research Center (DTRC) herd. An increase of numbers was necessary to more fully utilize the new facility that was dedicated in December, 1977. Typical of the support generated by Kansas dairy leaders in pressing for the DTRC, 67 dairy producers and friends donated heifers to the cause.

Seventy-two heifers were donated. Three heifers were lost prior to calving, including one freemartin, which became a member of the rumen fistula herd. The heifers were designated as "K-heifers", and the first one calved August 4, 1979. As of May 2, 1984, 14 K-heifers still remain in the herd.

Table 1 summarizes the change in herd size and production over the last 13 years. As noted, the influx of the K-heifers, starting in 1979, accomplished the desired goal of a 200+ milking herd. The 200th cow entered the herd in early 1980. Up to that point the primary goal was to obtain herd size with little emphasis on culling. As the herd approached optimum size, greater emphasis was placed on quality, and selection pressure against low production resulted in marked improvement in yearly per cow production. A critical nutrition experiment in 1981 saw a significant decline in production per cow but rapid recovery was made in 1982 and 1983.

Table 2 presents some statistical facts about the influence of the K-heifers in the DTRC herd. While some research funds are available to support the herd, no tax money is earmarked for herd maintenance. Thus, it is important that the herd be efficient in its operation, even though additional personnel are required under the civil service system and because of the research nature of the herd.

Table 3 lists some of the research projects in which the K-heifers participated. Even though a number of these trials would have been undertaken without expansion, one of the great limitations to research is the number of cows for observations. The more observations, the greater the probability of significant results. In addition, more cows mean more heifer calves for the important research efforts of calf nutritionist, Dr. J.L. Morrill. Another advantage of greater numbers is the benefit to animal science majors and veterinary students that use the herd for classroom observations. A large dairy herd adjacent to the campus is invaluable for veterinary students wishing to enter preventive herd health practices. The DTRC serves as a model in preventive dairy herd health programming.

Table 4 notes the disposition of the K-heifers that had left the herd as of May, 1984. The reasons for culling are not unlike the average for Kansas DHI herds. While low production is the leading indicator for culling, more than one-half are culled for other reasons. Nearly one-third was culled for reproduction and udder problems. Culling for reasons other than low production markedly reduces the genetic gain that could be realized from the cow's side. Consequently, most genetic gain must come from the sire's side, and pressure should be placed on selecting the best of sires to use in the breeding program.

Table 5 summarizes the total number of lactations by the K-heifers and a comparison of the average lactation with contemporaries or herdmates. For heifers culled, the terminal lactation is not included in the weighted average. The average K-heifer was superior to herdmates by more than 800 pounds of milk and nearly 30 pounds of milkfat per lactation.

A note of sincere appreciation is expressed to all of the dairy producers and friends of Kansas State University who helped make the herd expansion project most successful. The initial cost of investment (estimated $51,500) has been repaid many fold in the significance of the published research that these heifers help generate.

Table 1. Thirteen year D.H.I. summary, 1971-1983 (Rolling Herd Average).

Year	Cow Years	% in Milk	Milk (lb)	Milkfat (%)	Milkfat (lb)
1971	111.9	78	11,420	3.3	379
1972	115.7	85	13,482	3.5	469
1973	118.5	82	13,414	3.6	481
1974	124.5	83	13,836	3.3	456
1975	120.9	87	14,600	3.5	507
1976	125.7	84	14,415	3.5	502
1977	141.6	82	14,256	3.7	520
1978	140.3	81	12,475	3.8	473
1979	162.8	85	14,624	3.6	528
1980	205.6	89	15,169	3.6	552
1981	212.5	88	13,916	3.7	505
1982	216.8	87	15,631	3.5	543
1983	210.5	88	16,262	3.5	568

Table 2. Some facts about the K-heifers in the KSU DTRC herd (5-2-84)

a. Total days in milk:	54,502 (149.3 cow years)
b. Total milk production:	2,419,810 lb.
c. Total milk fat production:	89,490 lb.
d. Total value of product ($12.30/cwt):	$297,637
e. Total income-over-feed cost (avg. $1030/cow year):	$153,779
f. Estimated value of donated heifers:	$51,500

Table 3. A synopsis of research trials involving K-heifers

a. Effect of reduced protein intake in early lactation.

b. Niacin as a preventive measure against the fat-cow syndrome and ketosis.

c. Efficacy of treatment vs no treatment in cases of clinical mastitis.

d. Can high SCC be lowered by appropriate antibiotic treatment?

e. Suckling vs 2 X milking on ovarian function in postpartum dairy cows.

f. Treating cystic ovaries with GnRH and $PGF_{2\alpha}$.

g. Efficacy of $PGF_{2\alpha}$ in treating the anestrous cow with palpable corpus luteum.

h. Time of insemination and conception rates in dairy cows.

i. Can early fresh cows be self-fed grain? - A demonstration.

j. Effect of semen thaw temperature on conception rates in lactating dairy cows.

k. Milking characteristics of an internally regulated pulsator milker.

l. Limestone as an intestinal buffer in dairy cows.

m. Protein requirements for lactating dairy cows.

Table 4. Disposition of K-heifers removed from the DTRC (5-2-84)

Culling Reason	Lactation 1	2	3	4	5+	Total	(%)
Reproduction	7	3	2	-	-	12	22.6%
Low Production	7	5	5	4	1	22	41.5
Died	3	-	1	1	-	5	9.4
Udder roblems	1	-	2	2	1	6	11.4
Ketosis, milk fever	-	1	1	-	-	2	3.8
Other (injury, bloat)	1	4	1	-	-	6	11.3
Total	19	13	12	7	2	53	100%

Table 5. Total lactations and productive ability of K-heifers (5-2-84)

a.	Total lactations:	150
b.	Total lactation above herdmates, milk:	101
c.	Total lactation above herdmates, milkfat:	94
d.	Average difference from herdmates, milk:	+832 lb.
e.	Average difference from herdmates, milkfat:	+ 29.7 lb.

DEVELOPMENT OF AN EARLY WEANING PROGRAM FOR DAIRY CALVES[1]

J. L. Morrill, A. D. Dayton[2], A. J. Zmolek[3],
and M. A. Vitcenda[3]

Summary

After preliminary experiments, four trials were conducted to develop and test a new feeding program for calves. The program involves the use of a special feed (a prestarter) to encourage calves to eat dry feed and to provide high quality nutrients during the time of initial rumen development. Using this plan, calves were weaned at 2 weeks of age with good results.

Introduction

After calves are weaned, there is a reduction in labor required, less expensive feeds are needed, and the incidence of scours usually decreases. Previous research has indicated that calves could be weaned as early as 3 wk of age with good results. In spite of this, most dairy calves in the United States are weaned at 6 to 12 wk of age. Since the main factor that determines when calves can be successfully weaned is the amount of dry feed consumed, anything that would increase dry feed consumption would help in an early weaning program. We conducted a series of experiments to evaluate the use of a special feed (a prestarter) to stimulate intake and we developed a program for the use of this prestarter.

Experimental Procedure

Preliminary observations indicated that a prestarter composed of milk solids, supplementary fat, and additives (Table 1) increased dry feed consumption if mixed with a calf starter. In Trial 1, 21 bull calves were purchased from local dairy producers and assigned to one of three treatments. Each calf was fed colostrum until 3 days of age, then milk at 8% of birth weight daily, and either prestarter, starter (Table 2), or an equal mixture of the two. Daily feed intake and weekly calf weights were recorded and the health of each calf was monitered. The calves were weaned at 2 wk of age, if consuming 1 pound of dry feed daily.

The results of Trial 1 suggested that a feeding schedule involving the use of changing ratios of prestarter and starter would be advantageous. Three subsequent trials were conducted to evaluate different feeding schedules and methods. In each, bull calves were fed milk or milk replacer and prestarter or starter according to the schedule being evaluated. Feed consumption, weight gains, fecal scores, and other observations of health were recorded.

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[1]Partial financial support provided by Merrick Foods, Union Center, WI.

[2]Department of Statistics

[3]Merrick Foods.

Results and Discussion

In Trial 1, calves that were fed prestarter as the only dry feed consumed the most and gained the most during the first part of the trial, those fed a mixture of prestarter and starter consumed most and gained fastest during wk 4 and 5, and calves fed only starter performed best during wk 6 (Table 3). This suggested that a program providing prestarter as the only dry feed at first, then a mixture of starter and prestarter, and finally starter alone would give good results.

During the next three trials we tested various schemes and developed the following program which gave good results when calves were weaned at 2 wk of age.

1. Ensure adequate consumption of colostrum soon after birth and during the first 3 days of life.
2. Provide adequate individual housing.
3. Feed milk or diluted colostrum at 8% of birth weight daily, using an open pail.
4. Stimulate calves to eat dry feed by putting a small amount of prestarter in the milk.
5. Provide prestarter (Table 1) ad libitum.
6. Add palatable, fibrous starter when consumption of prestarter is ½ pound daily, first in small amounts, then increasing to appetite of calf.
7. Wean at 2 wk of age, if calf is healthy and eating dry feed well.
8. Continue to feed ½ pound of prestarter mixed with all the starter the calf will consume to 6 wk of age.
9. Allow access to hay unless starter contains adequate roughage.

Table 1. Composition of prestarter, %

Whey, dried	46
7-60[a]	23
Skim milk, dried	19
Sodium caseinate	12
Additives[b]	+

[a]A mixture of milk solids and fat containing 7% protein and 60% animal fat.

[b]Additives provided antibiotics, vitamins, and minerals.

Table 2. Composition of starter, %

Corn, ground	30
Alfalfa, ground	25
Oats, rolled	20
Soybean meal	10
Sorghum grain, rolled	7.5
Molasses, dry	5
Dicalcium phosphate	.7
Limestone, ground	.3
Salt	.25
Trace mineral salt	.25
Vitamin and mineral supplement[a]	1.00

[a]Provided 1000 I.U. vitamin A, 150 I.U. vitamin D, and .4 mg selenium per pound.

Table 3. Results of Trial 1

	Weight gain (lb)			Feed consumed (lb)		
Week	Starter	50-50 mix	Prestarter	Starter	50-50 mix	Prestarter
1	3.70	4.99	6.42	.92	1.28	2.60
2	2.86	6.42	3.15	1.89	2.82	2.99
3	7.26	3.15	3.85	7.00	8.40	4.55
4	3.85	6.84	2.29	1.39	15.16	9.53
5	7.83	11.97	6.71	19.07	20.79	12.54
6	12.98	9.55	2.42	25.59	22.90	13.86

EVALUATION OF AN EARLY WEANING PROGRAM FOR DAIRY CALVES

J. L. Morrill, M. K. Schmidt, A. J. Cullen,
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Summary

One experiment was conducted to compare an early weaning program, using a prestarter[2], when calves were weaned at 2 or 3 wk of age with programs using conventional feeds and weaning at 3 or 6 wk of age. Daily gains to 8 wk of age were 1.19 and 1.03 pound for calves fed a commercial starter and weaned at 6 and 3 weeks of age, respectively; and were 1.1 and .97 for calves on the early weaning program and weaned at 3 and 2 wk of age, respectively.

Another experiment was conducted to test one variation of the early weaning program. Calves fed according to the early weaning program and receiving a high quality, fibrous starter gained an average of 1.3 lb per day to 6 wk of age. Calves fed prestarter but no starter until weaning did not perform as well.

Introduction

The results of earlier experiments had led to the development of an early weaning program (see page 5). The program had not been tested in a direct comparison with more conventional programs so this was done in Experiment 1 of this study. In Experiment 2 we tested one modification of the early weaning program to see if it could be simplified even more.

Experimental Procedure

Sixty-eight Holstein heifer calves were used in Experiment 1. Calves in Groups 1 and 2 were fed prestarter ad libitum until they were consuming ½ lb each daily, then every day each calf was fed a mixture of ½ lb of prestarter and whatever amount of low-fiber commercial calf starter it would consume. Calves in Groups 3 and 4 were fed the same calf starter ad libitum. Chopped brome hay was available to all calves. Ages at weaning were 2, 3, 3 and 6 wk for Groups 1-4, respectively. Feed consumption, weight gains, and observations of health were recorded.

In Experiment 2, calves in one group were fed prestarter ad libitum until they were consuming ½ lb each daily, then every day each calf was fed a mixture of ½ lb of prestarter and all of a palatable, high fiber starter it would consume. They were weaned at 2 wk of age. Calves in the other group were fed only prestarter until weaning at 2 wk of age; after weaning they were fed the same as calves in the other group. Feed consumption, weight gains, and observations of health were recorded.

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[1] Department of Statistics
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Results and Discussion

Weight gains and feed consumption in Experiment 1 are shown in Table 1. Weight gains in any one wk were significantly different only in wk 3 when calves in Group 1 had been weaned and other calves had not. Sickness and mortality were very low in all groups and clinical appearance of all calves was similar.

Weight gains and feed consumption in Experiment 2 are shown in Table 2. The benefit of adding starter to the ration before weaning is obvious.

Calves in Group 1 in Experiment 1 did not gain as well as early-weaned calves in earlier experiments or as those in Group 1 in Experiment 2 of this study. Part of that difference may have been due to extreme weather conditions during some of the time Experiment 1 was underway. However, the starter used may have been a factor. The starter used in earlier studies and in Experiment 2 of this study was a high-fiber starter and was readily consumed by the calves.

The daily gain of 1.3 lb to 6 wk of age would be considered acceptable and, since calves have already gone through weaning stress, growth after 6 wk of age is very good.

Table 1. Weekly dry feed consumption and weight gains in Experiment 1

	Week								
Group	1	2	3	4	5	6	7	8	Overall
	Dry feed consumption, lb								
1	2.2	4.0	9.9	14.1	18.5	24.6^{a}	28.4	30.6	132.0
2	1.9	3.5	6.6	13.6	19.1	24.4^{a}	28.2	32.6	130.2
3	1.1	3.1	6.4	14.5	19.8	25.7^{a}	29.7	33.7	134.0
4	1.3	3.5	6.2	8.6	13.0	15.0^{b}	26.4	32.8	106.7
	Body weight gain, lb								
1	4.4	4.2	0^{a}	2.9	9.9	10.1	11.4	11.2	54.1
2	4.4	4.0	6.8^{b}	1.3	7.9	10.6	10.8	15.6	61.4
3	3.3	4.6	6.4^{b}	2.2	7.9	10.6	10.3	12.5	57.9
4	3.7	3.7	6.6^{b}	6.6	8.1	12.8	12.3	12.3	66.4

^{a,b}Means with different superscripts are significantly different ($P<.05$).

Table 2. Weekly gain and feed consumed by calves in Experiment 2[a]

	Gain, lb		Feed, lb			
			Prestarter		Starter	
Week	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
1	5.9	3.5	2.4	2.6	.7	0
2	5.5	3.7	2.4	3.1	1.5	0
3	1.1	0	3.1	2.9	7.7	5.9
4	9.0	5.3	3.1	3.1	15.4	9.7
5	13.2	10.1	3.3	3.1	21.6	15.0
6	18.3	9.9	3.3	3.1	30.6	19.4
Total	53.0	32.6	17.6	17.8	77.4	49.9

[a]All calves were weaned at 2 wk of age.

IMMUNOGLOBULIN CONCENTRATIONS IN SERUM AND NASAL SECRETIONS OF CALVES AT THE ONSET OF PNEUMONIA

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Summary

Immunoglobulin (Ig) concentrations in serum and in nasal secretions were correlated with pneumonia and diarrhea during the first 12 wk of life of dairy calves. The peak onset of pneumonia occurred between 2 and 4 wk of age when the calves' serum Ig G1, Ig G2 and IgA concentrations were lowest. As IgG2 concentrations increased, fewer calves developed pneumonia. Peak onset of pneumonia was also correlated with the lowest IgG and IgA concentrations in the calves' nasal secretions. Diarrhea often preceded pneumonia.

Introduction

Respiratory disease is one of the more serious problems affecting dairy calves. This problem often occurs between 1 and 5 mo of age, a period coinciding with the usual low point in serum Ig concentrations. A correlation had been demonstrated between low Ig concentrations in the first wk of life and pneumonia at 2 or 3 mo of age; however, it was not determined whether the pneumonia coincided with the lowest Ig concentration in serum of individual calves, or whether the concentration of a particular Ig class in serum or in respiratory tract secretions could be correlated with the onset of pneumonia. Diarrhea in the first wk of life may also be correlated with pneumonia at a later age.

The purpose of this study was to evaluate the relationship between diarrhea and pneumonia and the relationship between low Ig values in serum and nasal secretions and the development of pneumonia.

Procedure

Seventy-nine Holstein calves were evaluated twice daily for degree of scouring, feed consumption and clinical signs of disease such as blood in feces, rapid respiratory rate, elevated temperature, cough, or nasal exudate. Calf weights were determined weekly. The calves were housed in elevated stalls in a controlled environment building and were fed milk replacer (study A) or milk (study B).

Weekly serum and nasal secretions were collected and immunoglobulin concentrations determined by radial immunodiffusion.

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[1] Department of Laboratory Medicine
[2] Department of Surgery and Medicine
[3] Department of Statistics

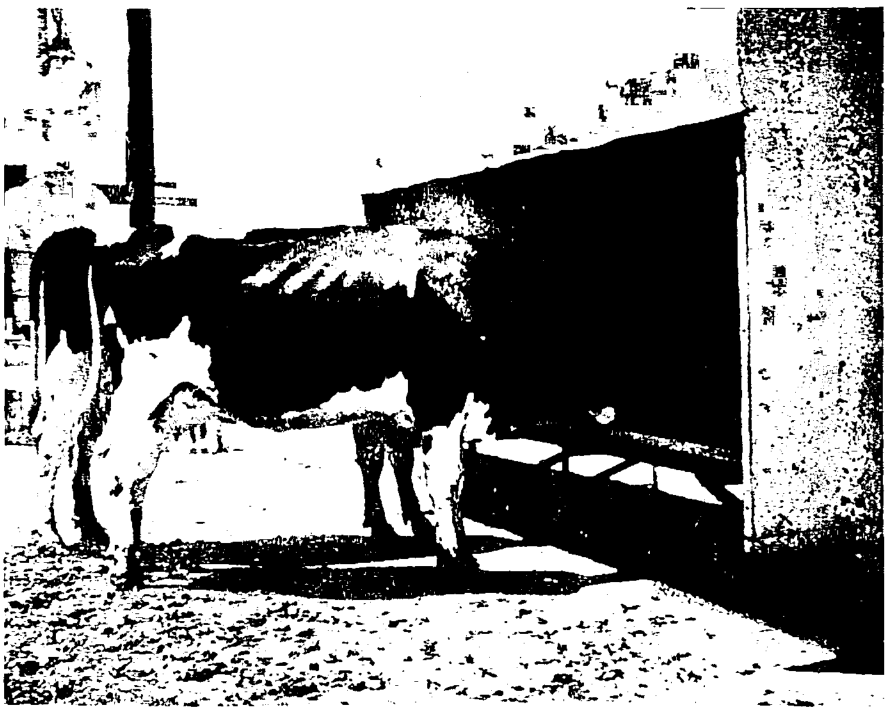
A criterion for diagnosis of pneumonia was developed. Pneumonia was characterized by fever, increased respiration rate, mild-to-severe depression, coughing, nasal discharge, serous ocular discharge, and dry or moist rales. When calves died, presence of pneumonia was confirmed at necropsy.

Results

All calves with pneumonia either had rectal temperature over 39.9C for one day, from 39.7 to 39.9C for 2 days consecutively, or 39.4 to 39.7C for 3 days consecutively and none of the calves without pneumonia had rectal temperatures within one of those categories.

In studies A and B, 58% of calves had diarrhea before pneumonia and 70% of calves had diarrhea before or starting on the same day as pneumonia. The wk with the highest occurrence of diarrhea preceded the wk with the highest occurrence of fever.

Serum Ig G1, Ig G2, IgM, and IgA declined to lowest values at 3 wk of age when peak prevalence of pneumonia occurred. IgA and IgM levels remained low, while Ig G2 concentrations increased markedly to maximum values at 11 wk of age. Most calves developed pneumonia when serum concentrations of Ig G1 were < 1.5 g/dl, Ig G2 < .3 g/dl, IgA < .1 g/dl, and IgM < .2 g/dl and when the combined IgG and IgA values in nasal secretions were < .2 mg of Ig/mg of protein.



EFFECT OF SUPPLEMENTAL VITAMIN E ON THE PERFORMANCE, METABOLIC PROFILES, AND IMMUNE RESPONSES OF DAIRY CALVES.

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Summary

Forty-six Holstein heifer calves were used from birth to 3 mo to study the effect of supplemental vitamin E at 1400 or 2800 mg dl-α-tocopherol acetate given orally at weekly intervals or 1400 mg dl-α-tocopherol by intramuscular injection. Weekly starter consumption was 10 to 27% more (P=.12) and weekly weight gains were 9 to 25% more (P=.13) in supplemented calves. Creatine phosphokinase activity was negatively correlated with serum tocopherol concentrations, indicating a subclinical muscular dystrophy in unsupplemented calves. Lymphocyte stimulation indices were positively correlated with serum tocopherol concentration. Calves given high level of oral supplementation had higher IgM antibody concentration. It was concluded that supplemental vitamin E is beneficial for calves reared on conventional complete starters to increase disease resistence and to obtain optimum performance.

Introduction

Modern calf management systems have shown a trend toward confined feeding of complete rations containing both grain and forage and less access to pastures. Under such conditions, several factors affect vitamin E requirements, including inadequate vitamin E in feedstuffs, stress conditions, and interrelationships with certain other nutrients in the diet. In calf rations, feedstuffs alone may not provide a sufficient amount of alpha-tocopherol, which is the most biologically active form of vitamin E.

Recent studies with laboratory animals and other animals have shown that vitamin E at levels much higher than those presently recommended enhances immune responses.

The objective of the present research was to study the effect of supplemental vitamin E on the general performance, metabolic profiles, and immune responses of dairy calves from birth to 3 mo under normal herd management conditions.

[1]Department of Laboratory Medicine.

[2]Department of Anatomy and Physiology

Experimental Procedures

Forty-six Holstein heifer calves were used in the experiment. Calves were allotted to one of 3 treatments: (1) 0 mg 2) 1400 mg and 3) 2800 mg of dl-α-tocopherol acetate fed orally at weekly intervals with a nipple bottle. Later calves were also allotted to a 4th treatment, which was 1400 mg of dl-α-tocopherol given by intramuscular injection at weekly intervals.

Calves were fed colostrum for the first 3 days and then milk at 8% of birth weight until weaning at 6 wk. Water and a complete calf starter (Tables 1 and 2) were always available to the calves. Calves were housed in fiberglass hutches throughout the experiment. Weight gains were recorded weekly. Fecal consistencies were scored twice daily.

Results and Discussion

Data on the performance and immune responses are in Table 3.

Although statistically not significant, weekly weight gains were 9 to 25% greater and weekly starter consumption was 10 to 27% more in supplemented calves. Fecal scores were the same for all calves.

Lymphocyte stimulation indices, considered to be the laboratory correlates for cell-mediated immune responses, were positively correlated with serum-tocopherol concentrations. This indicated that supplemented calves possibly had developed a better immunocompetency during their first weeks of life and thus were relatively more protected against diseases. Calves given a higher level of oral supplementation had higher IgM antibodies, suggesting capability for a better primary immune response.

Table 1. Ingredient composition of calf starter[1]

Ingredient	%
Corn, rolled	30.0
Oats, rolled	20.0
Sorghum grain, rolled	7.5
Alfalfa hay, ground	25.0
Soybean meal	10.0
Molasses, dry	5.0
Dical	0.7
Limestone	0.3
Salt, plain	0.25
Salt, trace mineral	0.25
Vitamin and Selenium premix[2]	1.00

[1] 3/16" pellets.
[2] 220264 IU of vitamin A, 33039 IU of vitamin D, 0.2159 g Na_2SeO_3/kg.

Table 2. Chemical composition of the calf starter (dry matter basis)

Crude protein %	15.61
Ether extract %	3.36
Acid detergent fiber %	19.95
Vitamin E, IU/kg	21.6
Selenium, PPM	0.44

Table 3. Performance, metabolic profiles and immune responses of calves (least square means averaged across weeks)

Variable	Oral Treatment			Injection	Probability
	0 mg	1400 mg	2800 mg	1400 mg	
Weekly starter consumption, kg	8.9	11.3	11.1	10.7	0.124
Weekly weight gains, kg	4.0	5.0	4.8	4.7	0.134
Fecal scores	1.2	1.2	1.3	1.2	0.247
Ig G_1, mg/100 ml	1240.1	1455.6	1460.6	1450.6	0.305
Ig G_2, mg/100 ml	134.1	169.8	152.4	180.2	0.226
Ig M, mg/100 ml	67.9	67.4	75.0	54.2	0.037
Lymphocyte stimulation index	44.9	64.1	77.2	132.7	0.0001

EFFECT OF PROCESSING TEMPERATURE ON UTILIZATION OF WHOLE SOYBEANS BY YOUNG CALVES[1]

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Summary

Two trials were conducted to determine the optimum conditions for processing whole soybeans for young calves. In the first trial, laboratory procedures and a nitrogen balance study were used. This information was used to design the second trial in which raw and processed soybeans were evaluated in an 8-wk growth trial using 96 Holstein day-old calves. Starters contained soybean meal (SBM), SBM with added fat, raw soybeans, or soybeans processed at 280, 340, or 375°F in a California Pellet Mill Jet-Sploder. Calves fed the starters containing soybeans processed at 340 consumed more feed, gained faster, had lower fecal scores (less scours), and less mortality.

Introduction

Soybeans have a high protein and energy content. However, raw soybeans contain several anti-nutritional factors, which may lower their feed value, especially for young ruminants and nonruminants. Proper heat treatment will destroy these factors and also will improve protein utilization by ruminants by increasing the amount of protein that escapes degradation in the rumen. These experiments were conducted in an attempt to determine the optimal heat treatment for soybeans to be fed to young calves and to evaluate a particular method for performing this treatment.

Procedures

In the first trials, soybeans were heat-treated using various combinations of temperature and time. The processed beans then were subjected to various laboratory tests and to metabolism studies to determine the optimum set of processing conditions.

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[1] We acknowledge the help of California Pellet Mill, San Francisco, CA in providing financial assistance and of Simonsen Feeds, Quimby, Iowa for processing some of the soybeans.

[2] Department of Statistics

[3] Department of Grain Science and Industry

Using the information gained earlier, a growth trial was conducted with 96 Holstein calves. They were fed milk until weaning at 5 wk of age and all of one of 6 calf starters (Table 1) they would consume from birth until 8 wk of age. The 6 starters were alike except for the supplementary protein sources which were either SBM, SBM with added fat, raw soybeans, or soybeans processed at 280, 340, or 375°F. A California Pellet Mill Jet-Sploder was used to process the soybeans. Growth rates, amounts of feed consumed, and various measurements of health were recorded.

TABLE 1. Ingredient and chemical composition of starters[a]

Item	Starters[b]					
	SBM	SBM + fat	Raw	280	340	375
	%					
Ingredients						
Corn cobs, ground	9.95	9.97	9.99	10.07	10.10	10.12
Corn, rolled	40.23	40.32	40.39	40.72	40.87	40.95
Oats, rolled	20.12	20.16	20.20	20.36	20.43	20.47
Soybean meal	15.29	15.85	—	—	—	—
Animal fat	—	1.57	—	—	—	—
Soybean, ground, raw	—	—	19.05	—	—	—
Soybean, ground, 280[c]	—	—	—	18.39	—	—
Soybean, ground, 340[c]	—	—	—	—	18.1	—
Soybean, ground, 375[c]	—	—	—	—	—	17.93
Sorghum grain, rolled	8.04	5.75	3.98	4.01	4.03	4.04
Dry molasses	4.66	4.67	4.68	4.72	4.74	4.75
Minerals and vitamins	1.71	1.71	1.71	1.73	1.73	1.74
Chemical analysis						
Dry matter	87.3	87.3	87.9	88.4	86.2	87.6
Crude protein[d]	17.2	15.5	14.3	15.6	15.4	16.6
Ether extract[d]	3.1	3.8	6.2	7.4	5.9	6.5
Crude fiber[d]	8.8	7.8	9.3	7.9	6.1	8.4
Ash[d]	4.9	7.3	5.1	5.2	4.7	4.8
Nitrogen free extract[d]	66.0	65.6	65.1	63.9	67.9	63.7

[a]As fed basis, except as indicated.

[b]Refers to supplementary protein sources. SBM=soybean meal; Raw=raw soybeans; 280, 340 and 375 = soybeans processed at those temperatures.

[c]Indicates processing temperature.

[d]Dry matter basis.

Results and Discussion

Results in the earlier trials indicated that the optimum treatment should be setting the Jet-Sploder to produce beans with an exit temperature of 340°F. Therefore, that treatment, a treatment with less heat, and one with more heat were chosen to be evaluated in the growth trial. The results of this trial are in Table 2. Growth rate, feed consumption, and health of calves were improved when the calves were fed starters containing soybeans processed to exit at 340°F. To reach that exit temperature the processing time is about 1 min. These results show that soybeans can be used to supply protein in calf starters, that the soybeans should be heat treated, and recommend the desired conditions for processing those beans. The CPM Jet-Sploder, which is energy-efficient, is satisfactory for processing the beans.

Table 2. Average weekly weight gains, feed consumption, and fecal scores, and mortality in growth study

Treatment[1]	Weight gain (lb)	Starter consumed (lb)	Fecal score[2]	Mortality[3]
340	7.6[a]	12.8[a]	1.58[a]	0
375	6.6[ab]	12.3[a]	1.86[ab]	0
280	5.1[bc]	9.7[ab]	1.97[b]	3
Raw	4.8[bc]	9.6[ab]	2.02[b]	2
SBM	4.3[bc]	8.8[b]	2.17[b]	4
SBM + fat	4.2[c]	8.4[b]	2.19[b]	3

[1] Refers to protein source in starter; see Table 1.

[2] 1=normal, 2=moderately soft, 3=semi-fluid, 4=watery.

[3] Number of calves that died.

[abc] Means within column with the same letter are not different ($P<.05$ for gain and fecal score, $P<.07$ for starter consumption).

EFFECT OF NIACIN SUPPLEMENTATION ON MILK PRODUCTION AND KETOSIS OF DAIRY CATTLE[1]

G. Dufva, E. Bartley[2], A. Dayton, and D. Riddell

Summary

Two lactation trials were undertaken to evaluate the effect of a niacin supplement on milk production and the physiological symptoms of ketosis. Blood ketone and non-esterified fatty acid levels were lower and blood glucose concentrations higher in niacin-supplemented cows. These trends were exhibited regardless of whether supplementation began 2 wk prepartum or immediately after calving. A 6 g daily dose was found to be of equal or higher benefit than a 12 g supplement. Cows given niacin consistently produced more milk than controls, though the difference was small.

Introduction

Many high producing cows in early lactation exhibit borderline ketosis. High production imposes a strain on energy metabolism manifested in the elevated blood ketone and lowered blood glucose levels of the ketotic cow. Niacin, a B vitamin closely associated with energy metabolism, has been shown beneficial to milk production and persistency. Therapeutic doses have alleviated blood changes and increased milk production of ketotic cows. These experiments were to determine whether daily supplementation with small doses of niacin before or during peak lactation would prevent physiological symptoms of ketosis.

Procedures

In the first experiment, 20 cows were put in 2 groups receiving either 0 or 6 g niacin daily beginning 2 wk prepartum. After calving, cows in the treatment group were given 12 g niacin daily until 4 wk postpartum.

In a second trial, 4 groups of 10 cows were supplemented postpartum only with 0, 3, 6, or 12 g niacin per day. In both experiments, blood samples from all cows were taken at regular intervals for analysis of beta-hydroxybutyrate (ketone), non-esterified fatty acid, niacin, and glucose.

Alfalfa was offered ad libitum but a concentrate mixture was limited to 13 and 9 kg/hd/day in Trials 1 and 2, respectively.

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[1] This study was partially funded by Lonza, Inc. Fairlawn, NJ.
[2] Deceased.

Results and Discussion

In both experiments, supplemented cows consistently produced more milk than controls, though the difference was slight. No significant effects on milk composition were noted in the first trial, while milk fat percentages in Trial 2 were higher for niacin-supplemented cows up to 8 wk postpartum.

Blood levels of ketones and non-esterified fatty acids, typically high if energy imbalance occurs, were lower with niacin supplementation while glucose concentrations were higher. These trends were evident regardless of whether supplementation began in the dry period or immediately postpartum as in Trial 2. A 6 g dose was found to give a equal or greater response than the 12 g daily dose. Niacin concentrations in the red blood cells (RBC) of control cows dropped 16.5% during the first wk postpartum. Cows receiving dietary niacin maintained the same RBC levels before and after calving.

Results from these trials showed the greatest response to dietary niacin, both on the physiological symptoms of ketosis and on milk production, to occur between the second and fourth wk of lactation.

EVALUATION OF RAW AND PROCESSED FULL-FAT SOYBEANS FOR HIGH-PRODUCING DAIRY COWS[1]

G. M. Ward, J. L. Morrill, M. B. Morrill,
and A. D. Dayton

Summary

Rations containing either soybean meal, raw full-fat soybeans, or processed soybeans were compared using 36 high-producing dairy cows in early lactation. The processed soybeans were heated in a California Pellet Mill Jet-Sploder for sufficient time (about 1 min) to produce beans with exit temperature of 340°F. The raw soybeans and heated soybeans were rolled before being mixed into the concentrate mixture. Alfalfa hay and concentrate were consumed ad libitum in a ratio of 35% hay and 65% concentrate.

Milk production and percent protein in milk were significantly greater when cows were fed soybean meal or Jet-Sploded beans than when fed raw soybeans. Percent milkfat and total milk solids were not affected by treatment.

Introduction

Soybeans are a good source of protein and energy; however, raw soybeans contain some anti-nutritional factors. Proper heat treatment will destroy those factors and may also increase the value of the soybean protein by altering the amount of protein that is degraded in the rumen. In another study[2], a Jet-Sploder[3] was used to process full-fat soybeans for young calves. Processing was beneficial, with one set of conditions being superior as determined by several criteria. In this experiment, we evaluated soybeans processed by those conditions in rations for high-producing dairy cows.

Experimental Procedure

Each of 36 cows having 305-2X-ME records of at least 16,000 pounds milk was assigned to one of three rations on the day after calving. The three treatments differed only in the composition of the concentrate (Table 1), which contained either soybean meal, raw soybeans, or jet-sploded soybeans. The jet-sploded beans were processed in a California Pellet Mill Jet-Sploder® adjusted to produce beans with an exit temperature of 340°F. This temperature required a processing time of approximately 1 min. The beans were rolled before being mixed with other concentrate ingredients. The raw soybeans were from the same

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[1]The assistance of Simonsen Feeds, Quimby, IA in processing some of the soybeans is appreciated.

[2]Abdelgadir et al (see p 16).

[3]California Pellet Mill, San Francisco, CA.

source and also were rolled before being mixed into the concentrate mixture. Each cow was subjected to each treatment for 28 days in a randomized, balanced changeover design. The cows were fed all they would consume of alfalfa hay and concentrate in a ratio of 35% hay, 65% concentrate.

The amount of feed consumed by each treatment group and milk produced per cow was recorded daily. The cows were weighed and composition of the milk was determined weekly.

Results and Discussion

Data on milk production and composition are shown in Table 2. Milk prodution and percent protein in milk was significantly greater when cows were fed soybean meal or Jet-Sploded full-fat soybeans than when fed raw soybeans. Percent milkfat and total milk solids were not affected by treatment. Cows consumed less concentrate and lost more weight when fed raw soybeans than when fed the other rations (Table 3).

Dry matter consumption was nearly the same for the soybean-meal and Jet-Sploded soybean rations but the Jet-Sploded soybeans were full-fat and thus provided more energy with only slightly less (5%) protein in the ration. Less of the raw soybean ration was consumed, resulting in less protein and energy than from either of the other rations.

Lower consumption of the raw soybean ration compared to either of the other rations appears to be the only reason for the response obtained, since each ration furnished protein in excess of requirements[5,6] and weight change was most negative for the cows on the raw soybean ration. Energy probably was the critical nutrient.

[5] National Research Council.
[6] Ward and Dayton JDS 61:1579(1978).

Table 1. Composition of concentrate mixtures

Ingredient	Ration 1	Ration 2	Ration 3
		%	
Rolled corn	85.275	82.025	82.025
Soybean meal (90% DM)	11.5	———	———
Cracked soybeans (90% Dm)	———	14.75	———
Jet-sploded soybeans (90% DM)	———	———	14.7
Cophos	1	1	1
Sodium bicarbonate	1.5	1.5	1.5
Potassium chloride	.5	.5	.5
Z-10 trace mineral	.025	.025	.025
Vit A & D suppl*	.2	.2	.2
	100	100	100

*1,000,000 IU vitamin A and 500,000 IU vitamin D per pound dispersed in ground corn.

Table 2. Daily milk production and percent milkfat, milk protein, and milk solids by rations.

Ration	Milk (lb.)	Milkfat (%)	Milk protein (%)	Milk solids (%)
1	73.9[A]	3.51	3.18[A]	12.3
2	69.7[B]	3.57	3.09[B]	12.4
3	73.3[A]	3.57	3.15[A]	12.4

A,B Treatment effect ($P<.05$).

Table 3. Hay and concentrate dry matter intake and weight change of cows, by rations

Ration	Hay intake lb/day	Concentrate intake lb/day	Weight change lb/week
1	19.6	38.4	-2.0
2	19.8	34.6	-4.9
3	20.6	37.8	-2.5

KSU

BIOAVAILABILITY OF ALFALFA CALCIUM

L. H. Harbers, G. M. Ward, and A. D. Dayton

Summary

The availability of oxalate and non-oxalate calcium in alfalfa was determined using a chick assay. Oxalate-bound calcium was found to contribute only 16% as much influence as nonoxalate calcium. The nonoxalate calcium in alfalfa was 18% more available than calcium carbonate (precipitated chalk).

Introduction

Previous work at Kansas State University demonstrated that part of the calcium in alfalfa is relatively unavailable to animals because it is in the form of insoluble calcium oxalate. Further studies were made comparing the relative availability of calcium from alfalfa, acid-extracted alfalfa with added calcium oxalate, and calcium carbonate, using the chick growth assay.

Materials and Methods

Alfalfa hay was extracted with 1N HCl (final pH 0.6) to add as a fiber source, so all groups received a 17.5% alfalfa base. Two alfalfa hays were treated with .28 N HCl (final pH 3.0) to extract soluble calcium, but leave calcium oxalate in the fiber. Twelve diets were prepared, all containing 17.5% alfalfa, or acid-extracted, or both. Reference diets contained three levels of laboratory grade calcium carbonate.

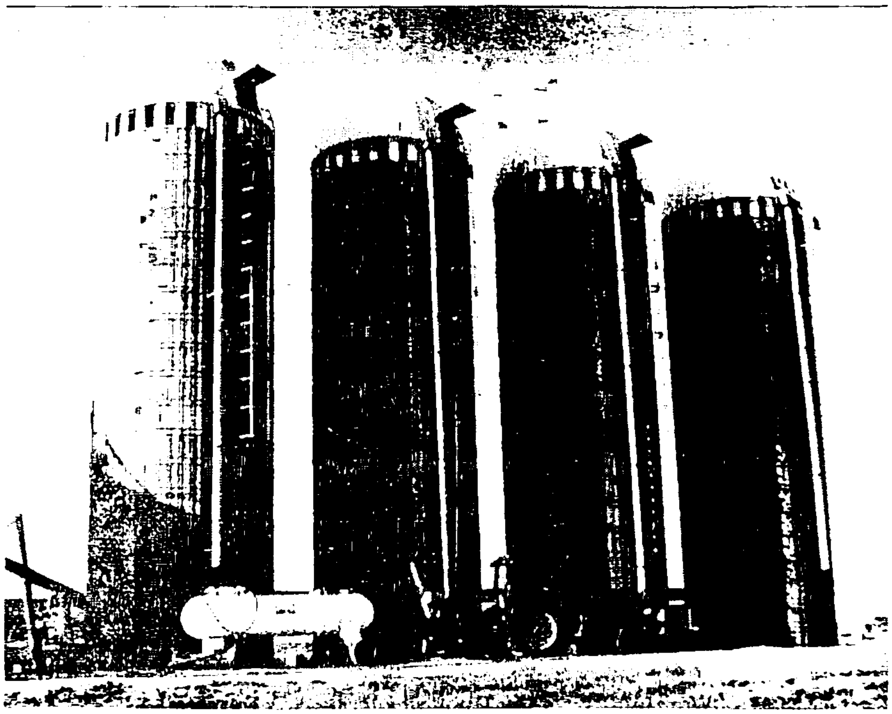
Day-old white Leghorn cockerels were alloted to three replicates of each treatment. Chicks were sacrificed on the 25th day. Response criteria were weight gain, pen feed consumption, and tibia bone ash.

Results and Discussion

Bird weight gain, intakes of oxalate calcium, non-oxalate calcium, total calcium, and tibia data (Table 1) indicate that gain and bone deposition are related to total calcium intake and oxalate-bound calcium. Statistical analyses of the data indicate that non-oxalate calcium in alfalfa is utilized 18% more efficiently in the chick than calcium carbonate. Oxalate calcium had only 16% as much influence as non-oxalate calcium. The two lots of alfalfa used had 23 and 27% of their calcium tied up with oxalate, thus the net utilization of total calcium from alfalfa would range from 79 to 94% of that from calcium carbonate (precipitated chalk) for chicks. We previously found that oxalate calcium ranged from 20 to 33% of total calcium in alfalfa.

Table 1. Least square means of chick weight gain, calcium intake, tibia weight, and ash from alfalfa hays and their extracted residues

Treatment	Oxalate Calcium	Non-Oxalate Calcium	Total Calcium	Weight gain	Tibia Dry	Tibia Ash
	(g)					
1	.05	.32	.37	67	.181	.063
2	.07	1.06	1.13	130	.286	.121
3	.08	2.01	2.09	185	.449	.214
4	.09	3.05	3.14	199	.512	.252
5	.15	.67	.82	123	.261	.102
6	.30	1.29	1.59	174	.370	.166
7	.38	.52	.90	104	.220	.080
8	.82	.70	1.52	128	.267	.106
9	.18	.77	.95	130	.277	.113
10	.38	1.35	1.73	174	.383	.175
11	.38	.48	.86	93	.211	.078
12	.87	.69	1.56	131	.272	.108



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GONADOTROPIN-RELEASING HORMONE AND CONCEPTION OF HOLSTEIN COWS[1]

J. S. Stevenson, M. K. Schmidt, and E. P. Call

Summary

To study the effects of gonadotropin-releasing hormone (GnRH) and timing of artificial insemination (AI) on fertility, 328 dairy cows were divided into four groups. Inseminations at first, second, or third service were done soon after detected estrus (0 hr) or 12 h later. One-half of the cows in each of the preceding groups received GnRH (100 µg) or saline within 30 sec after AI. Conception at first service was not improved by GnRH. But conception rates at repeat services were improved by 21% when cows received GnRH after AI. Time of AI (0 vs 12 hr) had no effect on conception. Administering GnRH at repeat services should improve conception rate of lactating dairy cows.

Introduction

Many factors are important when attempting a successful AI program. Conception rates are influenced by correct identification of estrus, proper thawing and handling of semen, and proper timing and technique of inseminations. Few problems are more frustrating than apparently normal cows that fail to settle (repeat-breeders). Causes for repeat breeding include higher than normal fertilization failure and early embryonic death compared with normally fertile cows and heifers. There are also indications that hormone imbalance or asynchrony could be a cause for repeat breeding. Our objective was to determine whether GnRH could improve fertility of inseminations and if altering time of AI from the a.m.-p.m. rule would affect conception adversely.

Procedures

Our study involved 328 Holstein cows randomly divided into four experimental groups. Cows in Groups 1 and 2 were inseminated soon after detection of estrus (0 hr) and cows in Groups 3 and 4 were inseminated 12 hr after estrus was observed (a.m.-p.m. rule). In addition, cows in Groups 1 and 3 received 100 µg GnRH (2 cc Cystorelin®) within 30 sec after AI and cows in Groups 2 and 4 received 2 cc saline as controls. Most of the inseminations (99%) were performed by one technician during the entire study. Treatments were conducted at all first, second, and third services. First services began no sooner than 6 wk postpartum at the first detected estrus.

Results and Discussion

Results of treatment effects for conception at first services are in Table 1.

[1] We gratefully acknowledge Dr. M. D. Brown and CEVA Laboratories, Overland Park, KS, for their donation of Cystorelin® and partial financial support for this study.

Administering GnRH to cows at first service did not improve conception rates. Cows in the 0-hr group were inseminated no later than 5 hr after first observed in heat and cows in the 12-hr group were bred between 6 and 22 hr after estrus was observed. However, altering the time of AI relative to first observed estrus did not affect fertility.

Table 1. Effect of GnRH and time of AI on first service conception (%)[a]

Time of AI	Treatment at AI		Total
	Saline	GnRH	
0 hr	37/85 (43)	34/68 (50)	71/153 (46)
12 hr	46/97 (47)	35/78 (45)	81/175 (46)
Total	83/182 (46)	69/146 (47)	152/328 (46)

[a]No. cows pregnant/No. cows inseminated.

Administering GnRH at repeat services improved (P<.07) conception rates (Table 2). Conception after repeat services improved 10 percentage points or 21% after GnRH treatment compared with saline controls. It appeared that earlier inseminations (0 hr) followed by GnRH resulted in higher conception for repeat as well as for first services (Tables 1 and 2).

Table 2. Influence of GnRH and time of AI on conception (%) for all repeat services[a]

Time of AI	Treatment at AI		Total
	Saline	GnRH	
0 hr	38/79 (48)	36/60 (60)[b]	74/139 (53)
12 hr	37/78 (47)	48/84 (57)	85/162 (52)
Total	75/157 (48)	84/144 (58)[c]	159/301 (53)

[a]No. cows pregnant/No. cows inseminated.
[b]Saline at 0 hr vs GnRH at 0 hr (P=.08).
[c]Saline vs GnRH (P=.07).

These results demonstrate that GnRH treatment can improve conception in repeat breeding cows. The mechanism by which fertility is improved is a subject of our ongoing research. It is likely that GnRH may be stimulating release of other hormones that can improve the probability of fertilization and/or maintenance of newly forming embryos.

Recommendations

Based on this study, we recommend that GnRH be used only for repeat services. However, because of cost, use of GnRH at third services may be the most economical.

PROSTAGLANDIN $F_{2\alpha}$ FOR LACTATING DAIRY COWS WITH SILENT ESTRUS[1,2]

S. S. Plunkett, J. S. Stevenson, and E. P. Call

Summary

Two experiments were conducted in 17 dairy herds in NE Kansas to determine the effectiveness of prostaglandin $F_{2\alpha}$ (PGF) for reducing intervals to conception for cows with silent or unobserved estrus. Cows that failed to be seen in heat so they could be inseminated after calving (Exp. 1) and cows that did not return to estrus after AI and were not pregnant when presented to veterinarian for pregnancy examination (Exp. 2) were assigned alternately to be given PGF or to receive no treatment after detection of a palpable corpus luteum. Cows were inseminated at 72 and 96 hr after PGF treatment if not detected in heat. Intervals from treatment to conception were reduced after PGF treatment. Cows with unobserved estrus can be inseminated sooner and have shorter intervals to conception if PGF is used for reproductive management in association with a routine herd health program.

Introduction

Intervals from calving to conception longer than 120 days are an economic liability to dairy producers. Failure to detect estrus is the primary reason for lengthy calving intervals rather than a cow's failure to conceive once inseminated. Missed heats occur in cows with delayed intervals to first service and in cows that do not conceive when bred and do not return to estrus approximately 3 wk after AI. Prostaglandin $F_{2\alpha}$ (PGF) is a potential solution to dealing with dairy cows with silent or unobserved estrus.

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[1] We acknowledge the donation of prostaglandin $F_{2\alpha}$ (Lutalyse®) and partial financial support provided by The Upjohn Company, Kalamazoo, MI.

[2] The authors express appreciation to the following Kansas dairy producers (and their veterinarians) for cooperating in this project: David Alderman, Ottawa (Dr. Larry Mages); Fisher Dairy, Frankfort (Dr. Harry Steinfort); Phil Freidrichs, Bremen (Dr. Arnold Nagely); Funk Dairy, Nortonville (Dr. Joe Kobuszewski); Ron Funk, Valley Falls (Dr. Joe Kobuszewski); Bill Harries, Herkimer (Dr. Arnold Nagely); Joe Heinen, Valley Falls (Dr. Joe Kobuszewski); James Hermann, Oskaloosa (Dr. Don Hrenchir); Charles-Chip Hornberger, Baldwin (Dr. J. C. Breithaupt); Kenneth and Marilyn Hubbard, Baldwin (Dr. J. C. Breithaupt); Arlon Jones, Pomona (Drs. Tom Taul and David Nottingham); James Lobb, Oskaloosa (Drs. Allen Meyer and Mike Kobuszewski); Helmith Ludders, Herkimer (Dr. Arnold Nagely); Duane Meier, Palmer (Dr. Harry Steinfort); Bob Ohlde, Linn (Dr. Harry Steinfort); Harris Ramsour, Alta Vista (Dr. Kirkimide); Bob Russell, Baldwin (Drs. Tom Taul and David Nottingham), and Mary Schmidt and Michel Jamshedi, KSU Dairy (Drs. David Carnahan and Mark Spire).

Procedures

Exp. 1. Dairy cows (n=223) that had not been observed in heat and bred by at least 6 wk postpartum were presented to herd veterinarians at a routine herd visit. Those cows with a palpable corpus luteum were assigned alternately to be an untreated control or to receive PGF (5 cc Lutalyse®). Cows were inseminated when observed in heat. If heat was not detected by 72 hr after PGF, cows were inseminated at 72 and 96 hr. If cows showed heat after 96 hr, they were reinseminated.

Exp. 2. Cows (n=85) with unobserved estrus after insemination and diagnosed open at pregnancy examination were assigned to a control or PGF treatment group as in Exp. 1 if a corpus luteum was palpated. Cows were inseminated as described for Exp. 1.

Results and Discussion

Exp. 1. Intervals from treatment to heat, first service, and conception were shorter (P<.01) for cows receiving PGF than for controls (Table 1). Conception occurred 22 days earlier (P<.01) for treated cows than for controls. First service conception and cumulative pregnancy rate were similar for control and treated cows.

Table 1. Dairy cows not inseminated because of unobserved estrus (Exp. 1)

Item	Control	PGF
Treatment to heat, days	23.1	3.1[a]
Treatment to AI, days	23.4	2.9[a]
Treatment to conception, days	59.3	37.2[a]
Conception at first AI, %	39 (27/69)	43 (57/133)
Cumulative pregnancy rate, %	88 (61/69)	86 (114/133)

[a]Less than control (P<.01).

Exp. 2. Intervals from treatment to estrus and first service were shorter (P<.01) for treated cows compared with controls (Table 2). Time from treatment to conception tended to shorter by 16.5 days for cows given PGF compared with controls. As in Exp. 1, first-service conception and cumulative pregnancy rates were similar between groups.

Table 2. Dairy cows open at pregnancy examination with unobserved estrus (Exp. 2)

Item	Control	PGF
Treatment to heat, days	19.6	3.3[a]
Treatment to AI, days	20.5	3.0[a]
Treatment to conception, days	45.6	29.1
Conception at first AI, %	52 (16/31)	44 (19/43)
Cumulative pregnancy rate, %	84 (26/31)	81 (35/43)

[a]Less than control (P<.01).

Recommendations

Treating unobserved or silent estrus with PGF will reduce conception intervals. If a corpus luteum is present, treat cows with 5 cc lutalyse® or 2 cc Estrumate®. Observe for estrus and AI when detected in heat. If no estrus is observed by 72 hr after treatment, AI cows at 72 hr and again at 96 hr. If cows show heat after 96 hr, rebreed. It is essential to bred cows at 72 and 96 hr in the absence of detected estrus for maximal results.

FACTORS AFFECTING ESTRUS AND FERTILITY OF HOLSTEIN HEIFERS AFTER PROSTAGLANDIN $F_{2\alpha}$ [1]

J. S. Stevenson, M. K. Schmidt, and E. P. Call

Summary

Stage of the estrous cycle, time of insemination, and season of the year were examined for their influence on estrus and fertility of 223 Holstein heifers after prostaglandin $F_{2\alpha}$ (PGF). Heifers given PGF early in the estrous cycle (days 5 to 8 where estrus = day 0) had shorter intervals (by 11 hr) to heat than heifers given PGF later in the cycle (days 14 to 16). Heats also were more closely synchronized for heifers treated early in the cycle. Season of the year had no effects on the interval to estrus or on proportion of heifers observed in heat. Conception rates were highest when heifers were bred after estrous detection. Inseminations by appointment at 80 hr after PGF reduced conception for heifers treated early in their estrous cycles. Variability of intervals to estrus can reduce fertility, if heifers are only bred at 80 hr after PGF without regard to when estrus occurred.

Introduction

Numerous factors have been identified or suggested to influence the success of inseminating heifers after synchronization of estrus with prostaglandin $F_{2\alpha}$ (PGF). Many studies demonstrated that age and breed of cattle, season, stage of the estrous cycle when treated, and timing of inseminations influenced the occurrence of estrus and fertility after PGF. This study was designed to evaluate the importance of three of these known variables in the same experiment, so recommendations could be made for using PGF to maximize fertility after synchronized estrus.

Procedures

Holstein heifers (n=223) no less than 13 mo of age and weighing no less than 750 lb were used from January 1981 to March 1983. Heifers were given 25 mg PGF (Lutalyse®) early (days 5 to 8) or late (days 14 to 16) in their estrous cycles. These treatments would cause regression of a developing corpus luteum for the early group and regression of a mature corpus luteum for the late group. This would allow comparisons of when estrus occurred and the fertility of those heat periods after PGF. Treatments were conducted in 12 different groups of heifers in all seasons of the year except summer (June, July and August) to test for seasonal effects. During the first year (1981) heifers were inseminated according to estrous detection and during the second year (1982) heifers were inseminated at 80 hr after PGF without regard to estrus. For each of the 12 groups, inseminations were performed by one technician using semen from the same sire for each group.

[1] The authors express appreciation to The Upjohn Company, Kalamazoo, MI for donating the prostaglandin $F_{2\alpha}$ (Lutalyse®). We also thank S. Durham, M. Jamshedi, M. E. Loucks, M. BenMrad, and S. S. Plunkett for their able assistance.

Results and Discussion

Occurrence of estrus was affected by when PGF was given during the estrous cycle but not by season of treatment. Table 1 illustrates intervals to estrus after PGF. Interval to estrus was 11 hr shorter when PGF was given early in the estrous cycle compared with later. Percentage of heifers detected in heat was not affected by time of PGF treatment during the cycle nor by season of the year. Overall, only 16% of the heifers were not observed in heat after PGF.

Table 1. Seasonal and stage of the estrous cycle effects on PGF-induced estrus and fertility for heifers

Item	Early			Late		
	Fall	Winter	Spring	Fall	Winter	Spring
Interval to estrus[a], hr	48.5	49.3	51.1	64.6	59.1	60.3
Detected in estrus[b]						
Number	14/18	28/31	39/47	19/20	26/32	38/48
Percent	77.8	90.3	83.0	95.0	81.2	79.2

[a]Interval to estrus for early vs late groups (49.5 vs 60.6 hr) was shorter for early cycle treatment (P<.01).
[b]Overall percentage for early vs late groups (84.4 vs 83.0%) was similar.

Fertility results are summarized in Table 2. Conception for early cycle heifers was less (P<.05) after timed inseminations at 80 hr (53.4%) than for inseminations according to heat detection (73.7%). Comparing early with late cycle treatments, AI at 80 hr showed lower (P<.05) conception in the early group. But when inseminations were made after heat detection, conception rates were similar between early and late treatments. Similar effects occurred for services per conception.

Table 2. Fertility of heifers after PGF-induced estrus at an early and late stage of the estrous cycle

Item	Early		Late	
First service conception	(n)	(%)	(n)	(%)
AI at estrus	28/38	73.7	29/43	67.4
AI at 80 hr	31/58	53.4[a]	44/57	77.2[b]
Services per conception	(Average)		(Average)	
AI at estrus	1.37		1.53	
AI at 80 hr	1.72[a]		1.28[b]	

[a]Different from early heifers inseminated at estrus (P<.05).
[b]Different from early heifers inseminated at 80 hr (P<.05).

Recommendations

Because of the effects of the stage of estrous cycle at the time PGF is given, it is better to observe heifers for estrus and inseminate according to estrus. Early cycle heifers come into heat sooner, so an 80-hr timed AI is too late for maximal fertility. Therefore, if heifers fail to show heat before 72 hr after PGF, AI those heifers at 72 hr in the absence of estrus. Otherwise, breed heifers when observed in heat. Season did not influence estrous response or fertility after PGF. However, summer inseminations (June, July and August) were not tested and may result in lower fertility.

RELATIONSHIP BETWEEN PRODUCTION AND REPRODUCTION IN 5,480 HOLSTEIN HERDS ENROLLED IN THE MIDSTATES PROCESSING CENTER[1]

E.P. Call and J.S. Stevenson

Summary

Reproductive parameters were evaluated in 5,480 Holstein herds involving 335,673 cows to determine the reported negative genetic effect of production on reproduction. While higher producing herds had a slight decline in days to first bred, this effect was offset by a similar increase in services per conception. The greatest effect was seen in the percent of cows open and the average days open. It was concluded that managers of higher producing herds are more aware of the need to get cows bred back after calving and implement the necessary practices to minimize the percent of cows not yet serviced and the average days open. The negative genetic relationship between production and reproduction may be overcome with sound management practices.

Introduction

Research in the U.S. and other countries suggests that there is a small but real negative relationship between production and reproduction. This genetic antagonism results in higher producing cows being bred later, taking longer to conceive, and requiring more services per conception. Since performance is a result of genetic and environmental factors, it is important to determine if managerial input can overcome the inverse genetic effect.

Procedures

An analysis was conducted of the 5,480 DHIA Holstein herds, involving 335,673 cows, which were processed by Midstates Processing Center, Iowa State University in April, 1983. The herds were stratified by rolling herd average (RHA) as shown in Table 1. RHA is a measure of average yearly (365 day) milk production per cow and includes days dry. Several reproductive parameters were evaluated, including days to first breed, minimum freshening interval, services per conception, and cows not yet bred following last calving. Data were reported by dairy producers as an adjunct to the production testing program. Only DHIA herds reporting reproductive information were included in the analysis.

[1]We gratefully acknowledge the cooperation of Dr. Tom Aitchison, Iowa State University, Ames, in supplying the data for this study.

Results and Discussion

In general, herds with higher RHA are more efficient as measured by income-over-feed costs. Cows at higher levels of production consume more feed but are more efficient in coverting feed into milk, since maintenance costs are the same for similar body weight cows regardless of level of production. As indicated in Table 1, there were no appreciable effects of production on minimum freshening interval. There was a slight but positive decline in interval to first service, which was offset by an increase in services per conception ranging from 1.7 to 1.9 as RHA increased. Since minimum freshening interval only involves cows actually bred, cows not yet bred after calving have no effect on freshening interval.

The latter parameter, cows open, reflects the primary difference between low and high-producing herds. While the study suggests that the overall effects of production on reproduction are minimal and that management can overcome reported negative genetic effects, managers of higher producing herds are more aware of cows not yet bred and take the necessary management practices to minimize the percent of cows not yet bred at a much earlier time after last calving.

Table 1. Herd reproduction summary of 5,480 Holstein herds processed through Dairy Records Processing Center, Iowa State University.

Number of herds	Herd average-milk (lb/yr)	Minimum[a] freshening interval (days)	Interval to first service (days)	Open cows[b] (%)	Open cows[b] (Avg. days)	Services per conception
71	8,034	413	99	43	156	1.7
383	10,187	400	88	40	147	1.7
1250	12,120	398	86	35	119	1.7
1911	14,014	400	87	32	100	1.8
1343	15,853	401	87	29	89	1.8
442	17,694	401	86	29	81	1.8
80	19,876	398	84	27	79	1.9

[a]Assumes last reported service was successful.

[b]Cows not yet reported bred since calving.

EFFECTS OF VARIOUS FEEDING, BREEDING & MANAGEMENT PRACTICES ON MILK PRODUCTION

J.R. Dunham

The March 1984 DHI summary of Kansas Holstein herds shows some interesting correlations of various feeding, breeding, and management factors to production (Table 1). The Rolling Herd Average (RHA) is an excellent evaluation of the efficiency of dairy herds since RHA and income-over-feed-cost are closely related. Although income-over-feed-cost is not profit, it provides the income for paying the other costs of producing milk. The goal of every dairy producer should be to increase the RHA in order to improve profitability. The following observations can be made from Table 1:

Feeding

Higher producing herds are fed more grain and more dry matter than those with lower RHA's. The rations of higher producing herds are composed up of about 12% more grain than those of lower herds, but hte higher RHA herds produce milk more efficiently, as shown by the milk/lb of grain or milk/lb of dry matter fed. Total feed cost increases with RHA but feed cost/cwt milk decreases, which results in more income-over-feed-cost for higher RHA herds.

Management

All of the management factors contributing to the RHA cannot be evaluated by the DHI report. However, high RHA herds have a higher percent of days in milk and fewer dry days than lower producing herds. More days in milk are accomplished with shorter dry periods, raising more replacements, and then culling first lactation heifers while they are still lactating.

Reproductive management does not seem to be much different in relation to RHA, except the number of days from calving to first service tends to be less in high RHA herds. Apparently, high production does not have a negative effect on reproduction. Most herds could shorten the calving interval by reducing the days between calving and first service.

An obvious management characteristic of high producing herds is the high summit milk yield. Apparently, feeding and management programs during the dry period and early lactation are such that fresh cows peak higher in their lactation curves than those in lower producing herds. A 60-day dry period is recommended. For high summit milk yields, starting about 2 wk before calving, dry cows should be fed the same forages as the lactating cows with about 15 lb of grain. Following calving, fresh cows should be on a high level of grain within a few days. The average age of cows in high RHA herds is lower than in low herds. Therefore, it cannot be concluded that high RHA herds have more mature cows. Also, the high RHA herds' first calf heifers are slightly younger.

Table 1. Correlation of rolling herd average with various feeding, breeding, and management factors.

Production Range	11,000 to 12,999 lb	13,000 to 14,999 lb	15,000 to 16,999 lb	17,000 to 19,999 lb
No. Herds	129	234	206	68
Cows/Herd	59	65	70	69
Rolling Herd Avg.				
Milk (lb)	12,043	14,022	15,992	17,877
% Fat	3.58	3.58	3.54	3.53
Fat (lb)	431	503	566	631
Feeding				
Grain (lb)	6,845	7,062	7,526	7,862
Forage D.M. (lb)	9,845	10,070	9,566	9,904
Total D.M. Fed (lb)	15,625	16,285	16,189	16,823
Milk/lb Grain	1.8	2.0	2.1	2.3
Milk/lb D.M.	0.76	0.85	0.98	1.05
Total Feed Cost ($)	706	780	823	899
Income - Feed Cost ($)	778	949	1160	1311
Feed Cost/Cwt Milk ($)	5.86	5.56	5.15	5.03
Management				
% Days in Milk	83	85	86	88
Days Dry	69	66	65	60
Calving Interval (Days)	403	399	402	400
Services/Conception	1.8	1.9	1.8	1.8
Days to First Service	86	80	83	80
Avg. Age (yr.-mo.)	4-04	4-03	4-00	3-11
Age 1st Calving (yr.-mo.)	2-05	2-05	2-04	2-04
Summit Milk Yield (lb)	52.0	58.4	65.0	71.8
Lactation Profile (lb)				
<100 days	48.3	55.5	63.2	68.5
100-200 days	39.5	45.0	51.3	57.0
>200 days	31.0	35.7	39.8	44.4
Breeding				
Sires of Replacement (PD$)	43	54	58	85
1st Lactation (PD$)	11	22	18	51
2nd Lactation (PD$)	-10	9	16	47
3rd Lactation (PD$)	-19	2	2	33
4th Lactation (PD$)	-33	-29	-24	-11
Service Sire Avg. (with PD)	83	89	95	112
Percentile Rank	65	70	75	88
Service Sires with PD (%)	48	60	68	86
Cows Identified by:				
Sire (%)	51	63	76	77
Dam (%)	76	83	92	93

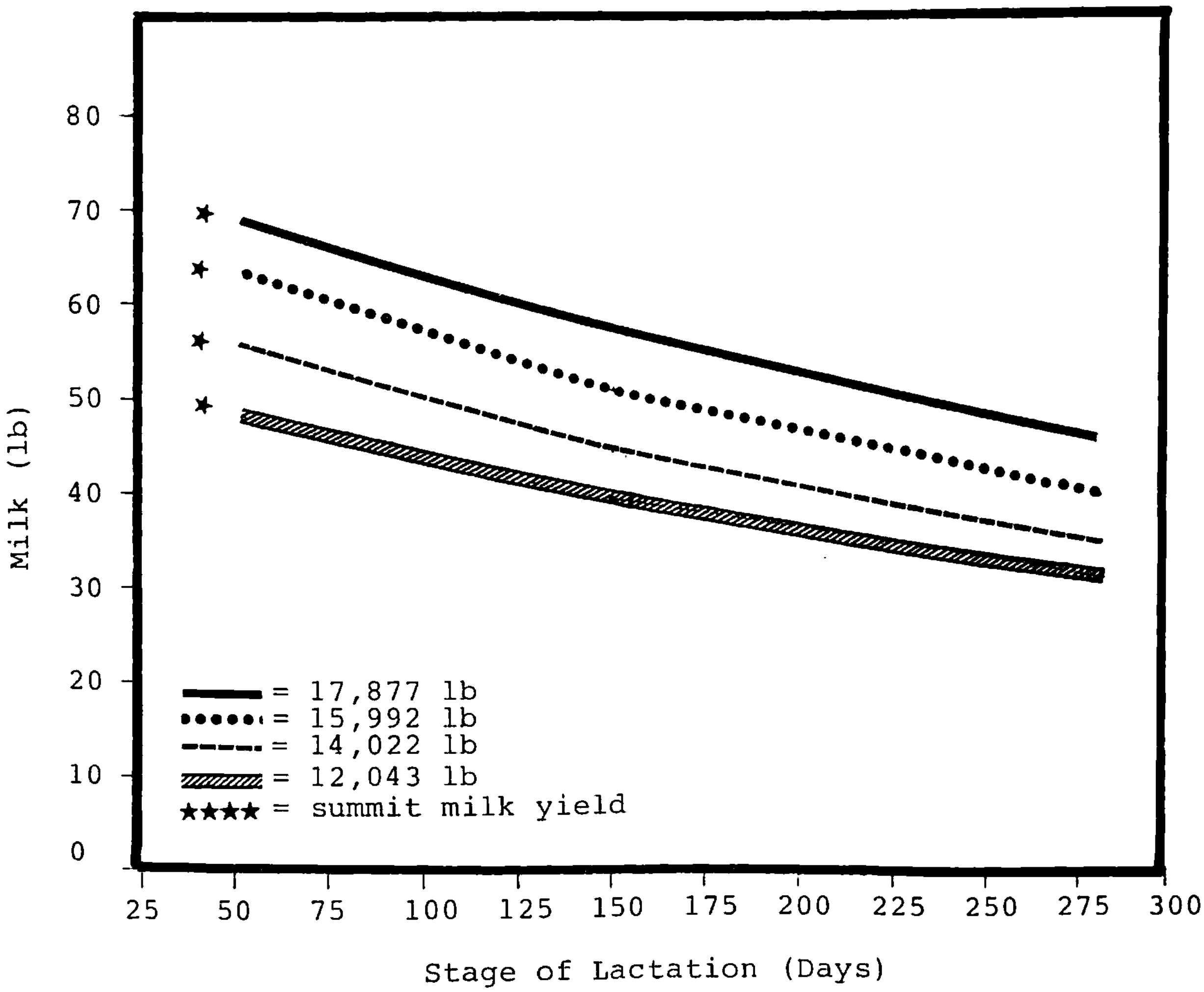
Breeding

Sire selection is closely related to the RHA. All age groups are shown to be sired by higher PD$ bulls as the RHA increases. In addition, the service sires currently being used have a higher PD$ value and higher percentile rank in the high RHA herds. High RHA herds use a larger percent of proven bulls than lower RHA herds. The goal should be 80/80, which means 80% of the cows bred to at least 80+ percentile rank bulls. The other 20% of the cows should be bred to several young AI sires to help prove the next generation of bulls.

Sound breeding decisions cannot be made without identification. Table 1 shows that the percent of cows identified by sire and dam increases with the RHA.

Figure 1 depicts the stage of lactation profile of the groups of herds summarized in Table 1. It is obvious that the higher RHA herds maintain the production advantage through all stages of lactation. Thus, in order to obtain high total lactation yields, cows must start their lactations at a high level.

Figure 1. Comparison of RHA, summit milk yield, and stage of lactation profile.



CULLING -- AN IMPORTANT MANAGEMENT TOOL

J.R. Dunham

The effects of heavier than normal culling on the Rolling Herd Average (RHA) can be illustrated from a survey of 30 Kansas DHI herds participating in the Dairy Diversion Program (Table 1).

During the first seven months of the program, 24% fewer cows were milked in the participating herds. Twenty of the 30 herds increased the RHA by 698 lb milk, while the increase averaged 334 lb for all herds. This increase corresponds to about 2 lb milk/cow daily. Typically, DHI herds increase production about 100 lb/year due to culling while maintaining herd size. Usually low production accounts for about 25% of the cows culled. Therefore, progress due to culling is rather slow, since 75% of the cull cows are eliminated for reasons other than production.

In addition to milking fewer cows to reduce total production, participants in the program are keeping cows dry longer, have lower percent days in milk, and are waiting longer to breed cows back. Of course, these practices tend to decrease the RHA. However, the Dairy Diversion Program has provided the opportunity for heavier culling, which should lead to more profitable herds in the future.

Table 1. Production comparisons of 30 DHI herds participating in the Dairy Diversion Program.

Date	No. Herds	No. Cows per Herd	Rolling Herd Avg.	% Days in Milk	Days Dry	Days to First Service
Dec. '83	30	81.5	14780	83.2	67.5	78.3
July '84	30	62.0	15114	82.3	71.7	80.7
Difference		-19.5	+334	-0.9	+4.2	+2.4

KSU

RESEARCH IN PROGRESS

*** RUMINANT PHYSIOLOGY ***

Evaluation of Lactate Production from Various Grain Sources and Their Water Soluble Fractions

A. J. Cullen and D. L. Harmon

Samples of corn, high moisture corn, wheat, whole barley, steam flaked barley, milo, steam flaked milo, beef pulp, and citrus pulp are being evaluated in vitro as to their ability to promote the production of lactate. Attempts are being make to relate the soluble carbohydrate content and composition to lactate production from individual sugars and thereby better understand what regulates lactate production and controls acidosis in ruminants.

Influence of Decoquinate on Rumen Fermentation

D. L. Harmon and T. G. Nagaraja

Decoquinate (Deccox®) is a commercially used coccidiostat that has been shown to significantly improve animal performance. Two experiments have been conducted to evaluate the influence of decoquinate on rumen fermentation. Two diets were used, 30 and 80% concentrate with decoquinate added at 0.5 or 5 mg/kg body weight. Samples of rumen fluid and plasma were taken to evaluate metabolite profiles, as well as samples of whole rumen contents, for measurement of in vitro, zero-time, volatile-fatty-acid production.

Influence of Ionophores on Net Portal Nutrient Absorption and Gut Metabolism

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

Animals fitted with abdominal aorta, hepatic portal and mesenteric venous catheters, as well as rumen fistula, were used to study the effects of ionophore addition on nutrient absorption and gut metabolism. Treatments were control, salinomycin (100 mg/head/day), and monensin (300 mg/head/day). Samples of portal and arterial blood were taken to evaluate absorption of volatile fatty acids, lactate, glucose, ammonia, betahydroxybutyrate, acetoacetate, pyruvate, glutamate, glutamine, as well as gut oxygen uptake.

Heat Stress Effects on Nutrient Absorption and Metabolism

A. J. Cullen, D. L. Harmon, T. B. Avery, E. Minton, and D. Nichols

Animals fitted with abdominal aorta, heptic portal and mesenteric venous catheters were used to study the effects of heat stress on portal blood flow and nutrient aborption. Animals were adapted to 65°F and allowed to consume an 85% concentrate diet containing monensin ad libitum, with the temperature increased to 80°F then to 95°F for a total of 48 hours. Samples of portal and arterial blood were taken 8 times during these temperature changes. Animals then were adjusted to 65°F and the sampling times repeated with animals fed the intakes they would consume ad libitum during the heat stress period. Both periods were repeated with analyses conducted for blood flow, absorption of volatile fatty acids, glucose glutamate, glutamine, and lactate, as well as oxygen uptake.

Effect of Sodium Bicarbonate and Sodium Bentonite on Forage Sorghum Silage and Silage Plus Grain Rations

K. Jacques, D. Axe, D.L. Harmon , K.K. Bolsen and T.G. Nagaraja

Maintenance of milk fat test and higher intake levels are often observed when buffers are added to dairy or grower rations. This experiment used rumen-fistulated cattle to examine the effects of two rumen buffering compounds, bicarbonate and bentonite, on sorghum silage-based rations. Measurements of silage fiber disappearance, volatile fatty acid production, pH and digestibility were taken to describe silage fermentation in the rumen. Marker substances were employed to determine how buffers affect flow rates of both fluid and fiber on silage rations.

Saliva Production and High-Producing Cows

K. Jacques, D.L. Harmon, T.G. Nagaraja, J. Morrill and R. Frey

Ruminants secrete tremendous amounts (100-190 liters/day) of well-buffered saliva. Saliva production differences between cattle are being investigated as one source of variation in the capacity of cows to consume the large quantities of feed needed to support high milk production. It is thought that saliva quantity may play a role in intake and nutrient utilization by influencing buffering ability and flow rates of fluid and digesta through the rumen to the small intestine.

*** CALF NUTRITION ***

Effect of Solubility of Protein in Calf Starter on Performance of Early Weaned Calves

J. L. Morrill, K. C. Behnke, and T. B. Avery

In an early weaning program that we are investigating, calves are fed a prestarter in which all of the protein comes from milk. Since this protein is rapidly degraded in the rumen, the extent to which protein contained in the calf starter is degraded in the rumen should be important. We are comparing three starters, each having soybean protein processed differently and therefore degraded at different rates in the rumen.

Effect of Buffer in Prestarter on Calf Performance and Rumen Function

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

The prestarter used in the early weaning program contains milk solids, fat and additives; therefore, all of the carbohydrate is lactose. The lactose may be fermented to lactic acid, which may cause reduced feed intake and affect rumen microbial development. We are studying the effect of adding sodium bicarbonate to the prestarter and are measuring health, growth, feed consumption, and rumen development.

Development of Procedures for Evaluation of Protein Utilization by Young Calves

P. G. Reddy, J. L. Morrill, and H. Minocha

The young calf is limited in its ability to utilize various types of proteins. We are limited in our ability to increase the utilization of protein by a lack of techniques that allow determination of partial tract digestibility, rapid detection of immune responses, and measurement of certain metabolic responses. Research is underway to develop and improve our methods of measurement of these responses. Following this, we will use these techniques to determine which protein sources can be used by the young calf and how these sources may be improved.

*** REPRODUCTION ***

Alternatives for Rebreeding Open Cows After Pregnancy Examination

K. D. Frantz, E. P. Call, and J. S. Stevenson

We demonstrated earlier that cows found open at pregnancy check with a palpable corpus luteum will respond to prostaglandin $F_{2\alpha}$ (PGF) and return to estrus sooner, rebreed sooner and conceive about 2 weeks earlier than cows that are not treated (controls) but bred at next repeat estrus (see research report in this publication). To further study alternatives for successful treatment of open cows, we are conducting the following experiment. Cows with a palpable corpus luteum and not pregnant at pregnancy examination will be assigned to one of the following treatments: (A1) Cows will receive PGF and be inseminated at estrus; (A2) Same as A1 but inseminated at 72 and 96 hr after PGF in the absence of detected heat; (B1) Same as A1 plus cows will receive GnRH at AI; and (B2) Same as A2 plus cows will receive GnRH at 72 hr after PGF.

Alternatives for Handling Repeat Breeders

K. D. Frantz, E. P. Call, and J. S. Stevenson

We demonstrated that giving gonadotropin-releasing hormone (GnRH, Cystorelin®) to repeat breeding cows will improve chances of conception by up to 21% (see research report in this publication). To find other successful methods for handling repeat breeders in order to maximize conception and minimize reproductive culling losses, we are conducting further studies. Cows that have failed to settle to previous services will be assigned to one of the following treatments: (A1) Control cows will be inseminated at repeat estrus; (A2) Same as A1 but cows will receive GnRH at AI; (B1) Cows will receive 25 mg prostaglandin $F_{2\alpha}$ (PGF) 9 to 12 days after repeat estrus and will be inseminated at estrus; (B2) Same as B1 but inseminated at 72 and 96 hr after PGF in the absence of detected heat; (C1) Same as B1 plus cows will receive GnRH at AI; and (C2) Same as B2 plus cows will receive GnRH at 72 hr after PGF.

Use of Prostaglandin $F_{2\alpha}$ (PGF) and Timed AI to Control Time of First Service for Lactating Dairy Cows

M. C. Lucy and J. S. Stevenson

Prolonged calving intervals are one sign of reproductive inefficiency. Maximum milk production occurs when the average calving interval in a herd is 12-13 mo and variation in calving intervals among herdmates is reduced. Research has demonstrated that number of days to first service has a direct effect on calving interval. With this in mind, we are controlling time of first service of dairy cattle using PGF and timed AI. Estrous cycles of cows are synchronized with PGF and then cows are inseminated at 54 to 60 days postpartum according to three different timed AI regimens. This trial will demonstrate what effect controlling time of first service has on calving interval. In addition, the most effective method of timed AI after PGF for dairy cattle should be elucidated.

Effect of Gonadotropin-Releasing Hormone (GnRH) at First Service on Serum Concentrations of Luteinizing Hormone, Progesterone, and Estradiol for Lactating Dairy Cows

M. C. Lucy and J. S. Stevenson

Research has demonstrated that GnRH given at the time of insemination improves fertility. This may occur because the GnRH-induced LH release causes enhanced corpus luteum function. To test this hypothesis, we are synchronizing estrous cycles of cows with PGF and then administering either saline or GnRH 8 hr prior to insemination. Blood is collected around the time of estrus and for 3 wk after insemination. Serum is being assayed for LH, progesterone, and estradiol. With this information we will determine what effect GnRH has on these serum hormones around the time of estrus and during early pregnancy.

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RELEVANT RESEARCH[1]

Effects of Forage Particle Length

J.R. Dunham

Alfalfa hay chopped to a mean particle length (MPL) of 0.45, 0.34, 0.23 or 0.11 inches were compared at Wisconsin to study the effects on dry matter intake and fat tests. Cows consuming the two longer MPL forages produced 3.6% milk fat compared to 3.2% from cows consuming the rations containing the two shorter MPL forages. Although this work was done with alfalfa hay, some dairy producers may be chopping haylage and silage too fine.

Comparison of Baled Alfalfa Hay vs Bagged Alfalfa Haylage

J.R. Dunham

Research from Utah and Michigan indicates that storing alfalfa haylage in bags is more economically feasible than storing alfalfa as baled hay. Early lactation cows fed haylage made from the same field as the baled hay produced more milk and 27% more dry matter was harvested per acre.

Soybean Meal vs Corn Gluten Meal With or Without Whole Cottonseed

J.R. Dunham

Total mixed rations supplemented with soybean meal or corn gluten meal with or without whole cottonseed were compared in a study at the University of Idaho. Dry matter intake and milk production were similar between the two protein supplements. However, milkfat percent was higher (3.55% vs 3.68%) and protein percent was decreased (3.26% vs 3.17%) from cows fed corn gluten meal. Cows fed whole cottonseed consumed more dry matter and produced about 6 lb more milk daily than those cows not fed whole cottonseed.

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[1]Summaries of significant research being conducted at other institutions, which is of interest and useful to Kansas dairy producers.

Rumen Microbiology in the Future: Manipulating Rumen Fermentation with Genetic Engineering - A Review

K. Jacques

In the past decade, advances in molecular biology and genetic research have shown tremendous potential for the future of agriculture. The new technology of recombinant DNA make it possible to one day "design" or "engineer" rumen bacteria with special characteristics.

The use of recombinant DNA involves the ability to extract genetic material from one source, "recombine" this DNA with a vector to carry it, place this genetic message into a suitable host, and obtain expression of the new DNA from that host. To date most success with such genetic engineering has been in causing certain strains of bacteria to overproduce a single protein like insulin or interferon. Because rumen bacteria are parts of an entire microbial ecosystem the situation is much more complex, but such a goal for the future is realistic.

One approach to genetic manipulation of the rumen system is to control the degradation of specific feedstuffs like cellulose. Increasing the rate and extent of cellulose digestion by a selected species is possible by gene amplification of that species' cellulose-digesting enzymes. Another goal is to control protein degradation such that ammonia release and carbohydrate digestion are more closely timed to promote more efficient feed utilization in the rumen.

A second approach is to manipulate the balance of fermentation end-products. Several species of bacteria ferment the same substrate but produce different proportions of volatile fatty acids and other metabolites. A competitive advantage could be given to the more efficient species. Other examples are prevention of the rapid accumulation of lactic acid that accompanies a ration switch to high concentrate or formation of the bloat-related polysaccharide capsule of Streptococcus bovis.

A third approach is to introduce into rumen microbes the ability to make certain previously limiting compounds that would augment fermentation like B-vitamins or benefit the animal like methionine.

The possibilities are limitless; but a much greater understanding of the complex biochemical interrelationships in the rumen and between the microbes and their ruminant host is needed before genetic engineering can begin. Over the past 20 years much has been learned about rumen microbiology, as individual species are isolated and their metabolic pathways studied. Additional information is obtained as we manipulate rumen fermentation by adding special nutrients or ingredients like antibiotics, ration buffers, or by studying the response of microbial populations when cattle change rations or stages of production. Once the necessary knowledge is in place, genetic engineering may provide the potential to further take advantage of the ruminant's special abilities to utilize low quality proteins, non-protein nitrogen, and fibrous feeds.

"Bypass" or "Escape" Protein - A Review

K. Jacques

Rumen microbes take protein and non-protein nitrogen from grains and forages and synthesize their own microbial proteins. Microbial cells, plus any feed protein escaping rumen degradation, then are digested and utilized by the ruminant. In many cases, particularly where poor-quality forages and most concentrates are concerned, the microbial protein formed represents an improvement in protein quality available to the animal. However, rumen microbes also use initially high quality protein feeds, like soybean meal, to form the same microbial protein, thus lowering its original value. It is beneficial for some of the better quality proteins to escape rumen fermentation and be digested and absorbed in the abomasum and lower intestine.

The best way to partition protein digestion between the rumen and hindgut is not yet clear. Protein sources differ naturally in the extent to which they are available in the rumen; and the same protein source fed with different ration ingredients will yield different extents of "bypass". These variables, plus effects of intake and production level, make it difficult to assign constant "bypass" values.

Much work is being done to determine an optimal balance between ruminal and post-ruminal protein degradation, which will both maximize rumen potential to use low quality protein and present the small intestine with the amino acid balance best able to support growth and milk production. Among the areas of research on bypass protein are:

*Feed processing treatments to protect protein from rumen fermentation
*Milk production and weight gain responses to protein protection
*How feed protein sources vary in rumen degradability
*Protection of particular amino acids
*Effects of intake level, various forage and concentrate combinations to protein digestion site

Choline and Metabolic Disorders

K. Jacques

Choline is a metabolic essential for building and maintenance of cell structure, and is of special importance in the transmission of nerve impulses. Choline also plays a role in transport and metabolism of fatty acids in the liver and deficiencies have been implicated in ketosis and fatty liver syndromes.

Recently, Maryland researchers found that added dietary choline increased milk production and milk fat synthesis on low forage (75% concentrate, 25% corn silage) diets. Their conclusion was that the low choline levels typical of high concentrate diets may contribute to the low fat milk syndrome by limiting transport of fatty acids to the mammary gland for synthesis of milk fat.

Supplemental Short-Chain Volatile Fatty Acids

K. Jacques

The branched-chain 4 and 5-carbon volatile fatty acids, isobutyric, isovaleric, 2-methylbutyric, and valeric acids are essential nutrients and enhance growth of rumen cellulolytic bacteria. These acids are normally produced in the rumen as products of amino acid degradation. Several studies, both in vitro and in vivo, have shown beneficial effects of added 4 and 5-carbon branched VFAs on high forage diets. Recently, Cornell, Virginia Polytechnic Institute, and Michigan State tested effects of these acids added to lactation diets. The blend of acids used was effective in increasing milk, fat-corrected milk, protein, and solids-non-fat, and total solids production of cows fed corn silage and concentrate rations. In addition to enhancement of cellulose digestion, improvement in nitrogen utilization was thought to contribute to the overall improvement in feed utilization.

Energy Utilization: Fat in Dairy Rations

K. Jacques

Supplementary fats have long been examined as a way to increase energy density of lactation rations. However, use of high fat rations has been prevented due to adverse effects on rumen microbial populations, depression of fiber digestion and milk fat, and management problems. Ohio researchers are trying to circumvent these problems by experimenting with feeding fat both as a performed calcium compound and by applying fat to the inert carrier, verxite. Both compounds escape rumen fermentation, thereby lessening the impact on rumen microbes and fiber digestion. Acid digestion in the abomasum and detergent action of bile acids dissociate the compounds, making the fat and calcium available post-ruminally. Both compounds are "dry fats", thus making transport and mixing much easier than fat used in liquid form. Though these methods represent improvements over earlier approaches, more work is being done to assure breakdown of the compounds in the hindgut and to prevent loss in the feces.

Rumensin Approved for Dairy Replacement Heifers

J.R. Dunham

Dairymen can now use a feed additive for heifers, which will improve growth rate and feed efficiency. The FDA has granted Elanco Products Company approval for use of Rumensin in dairy replacement rations. First marketed in feedlot cattle in late 1975, Rumensin also is widely used in cattle on pasture. In 10 experiments with replacement heifers, 150 to 200 mg of Rumensin per head per day increased daily gains by an average of about 10%.

Improved weight gains in replacement heifers are important to dairymen for several reasons. First, the more rapid gains from Rumensin result from more energy, which means gains are more efficient. Second, larger size in dairy heifers permits earlier breeding and calving and higher lifetime productivity.

Research at Arizona State University and the University of Idaho shows that body size is more important than age in regard to sexual maturity, breeding, and calving. In Idaho, heifers with accelerated growth rates were 1.9 mo younger than other cattle when they first came into heat. Generally, ideal breeding weights of dairy replacement heifers are 650 to 800 lb, depending on breed. By increasing gains an average of 10%, Rumensin can help dairymen achieve these breeding weights at an earlier age.

Research also has demonstrated that Rumensin has no adverse effects on reproduction of heifers. When fed at three times the recommended level, Rumensin did not affect conception, calving ease, number of live calves born, calf birth weight, milk quality, or production.

Rumensin is not approved for use in lactating dairy cows.

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American Soybean Association, St. Louis, MO
Archer Daniels Midland Company, Decatur, IL
California Pellet Mill, San Francisco, CA
CEVA Laboratories, Overland Park, KS
Cnurch and Dwight Company, Piscataway, NJ
Connaught Laboratories, Swiftwater, PA
Hoffmann - LaRoche, Nutley, NJ
Livestock and Meat Industry Council (LMIC), Manhattan, KS
Lonza, Inc., Fairlawn, NJ
Merrick Foods, Inc., Union Center, WI
Rhone - Poulenc Company, Atlanta, GA
A.H. Robins Company, Richmand, VA
The Upjohn Company, Kalamazoo, MI

Companies and brand names used only for easier communication. They imply no preference or endorsement.

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Statistics
Anatomy and Physiology
Laboratory Medicine
Grain Science
Surgery and Medicine

Contribution 85-116-S, Department of Animal Sciences and Agricultural Experiment Station, Kansas State University, Manhattan, KS 66506.

The Livestock and Meat Industry Council, Inc.

(LMIC)

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

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

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The Council's individual projects are numerous. 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. 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 get the research results we need so badly, our industry needs to supplement state and federal funds. Our industry needs to help suppport its own research and teaching programs to train tomorrow's industry leaders.

LMIC is asking stockmen, agribusinessmen, and friends of the livestock and meat industry for liberal contributions. Gifts can be cash, livestock and other gifts-in-kind, and land. Land gifts can be set up as a unitrust which 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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