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Comparison of three fresh cow feeding programs (2003)

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COMPARISON OF THREE FRESH COW FEEDING PROGRAMS

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Summary

We evaluated the impact on performance of top dressing a based total mixed ration (TMR) with long-stem alfalfa hay with or without additional dry-rolled corn to the lactating cow diet during the first 5 days postpartum. The three dietary treatments and numbers of cows assigned to each diet were: 1) total mixed ration (TMR; n = 19); 2) TMR + long-stem alfalfa hay (TMR + A; n= 20); and 3) TMR + long-stemmed alfalfa hay + dry-rolled corn (TMR + A + C; n = 20). Top dressing the lactating TMR with long-stem alfalfa hay with or without dry-rolled corn did not reduce the incidence of metabolic disorders in early lactating cows. Six cows, two on each diet, were treated for displaced abomasums. Cows consuming only the TMR lost slightly more body weight during the first 30 days after calving compared to cows fed the other diets. Milk and energy corrected milk (ECM) yields were similar among diets. Fat, protein, and urea nitrogen content in milk were not different among dietary treatments. Lactose content in milk was greater for cows consuming TMR + A than those consuming TMR or TMR + A + C. Concentrations of glucose and urea nitrogen in plasma were not affected by treatment during the initial 5 days of lactation. Concentrations of glucose and urea nitrogen on days 2 and 3 were less for multiparous cows consuming TMR than for multiparous cows consuming TMR + A. Rumen contractions during the first 5 days of lactation were not different among diets. Top dressing the lactating TMR with long-stem alfalfa hay with or without dry-rolled corn was not beneficial in this study. On a dry matter basis, the lactating TMR contained 22% chopped alfalfa hay, 10% corn silage, 20% wet corn gluten feed, 9% whole fuzzy cottonseed, 7.1% expeller soybean meal, 27.4% ground shelled corn, 1.2% molasses, 1.3% Menhaden fishmeal, and 2.0% mineral-vitamin premix. Cows fed diets containing corn silage as the predominant fiber source may respond differently.

(Key Words: Transition Cows, Alfalfa, Dry-rolled Corn)

Introduction

The most problematic time in the life of a dairy cow is the first 2 weeks after calving. Metabolic adjustments to the demands of the mammary system must occur, and the rumen must adjust to an energy dense diet. Close-up diets partially adapt rumen microorganisms and epithelium to the lactating diet, but rumen adaptation is driven by diet changes and the normal postpartum increase in feed intake required to support the increasing demands of the mammary gland. In most cases, energy intake is less than energy expenditure in early lactation. The metabolic adaptation to this negative energy balance is fat mobilization from adipose tissue. Mobilized fat is processed by the liver and serves as a source of energy and milk fat precursor. Fatty liver and ketosis occurs

when the rate of fat uptake exceeds the liver's ability to process it. One of the rate limiting steps in fat processing by the liver is availability of glucose.

During the dry period the dairy cow is fed a diet containing high levels of neutral detergent fiber (NDF), and rumen environment is altered with respect to microbial populations and absorptive capacity of the ruminal epithelium. Decreased feed intake typically observed immediately before parturition reduces rumen fill and likely diminishes the rumen mat. A rapid change from a high fiber, low starch close-up diet to a low fiber, high starch lactating diet may contribute to subacute ruminal acidosis. Ruminal acidosis has a negative impact on dry matter intake and exaggerates the negative energy balance normally observed early postpartum. Reduced dry matter intake lessens the amount of glucose precursors available to the liver for fatty acid oxidation and could result in fatty liver and ketosis. We hypothesized that the addition of long-stem alfalfa hay would increase rumen fill, moderate rumen pH, and improve intake during transition from the close-up to the lactating diet. However, additional hay reduces the concentration of rumen-available starch in the diet and could decrease the supply of gluconeogenic substrate. Thus, additional corn grain was offered in one of the diets in addition to being top dressed with long-stem alfalfa hay to maintain dietary starch concentration.

Procedures

Before calving, each cow was offered 20 lb daily of the lactating cow total mixed ration (TMR) with free choice prairie hay and water. Thirty-three multiparous and 27 primiparous Holstein cows were utilized in a randomized block design. Cows were blocked by calving date and parity before parturition, housed in group pens, and assigned randomly to one of three dietary treatments: 1) lactating TMR (TMR; n = 19); 2) TMR + 3 lb of long-stem alfalfa hay (TMR + A; n = 20); and 3) TMR + 3 lb of long-stem alfalfa hay + 3 lb of dry-rolled corn (TMR = AC; n = 20). Ingredient and chemical composition of the lactating TMR is shown in Table 1. Each identical pen consisted of commingled primiparous and multiparous cows fed one of the experimental diets. The TMR was mixed and offered thrice daily for ad libitum intake during the initial 5 days of lactation. Long-stem alfalfa hay was top-dressed at the 6 a.m. feeding of the TMR for diet TMR + A and TMR + A + C. Dry-rolled corn was offered individually to cows consuming TMR + A + C diet before the noon feeding of TMR. On day 6 of lactation following dietary treatments, cows were relocated and commingled with the remainder of the herd and offered the basal TMR for ad libitum intake.

Cows were milked twice daily and individual milk weights recorded at each milking. Milk samples were collected weekly for subsequent analysis of fat, protein, lactose, somatic cells (SCC), and urea nitrogen (MUN) by Heart of America DHI, Manhattan, Kan. Plasma was harvested from the coccygeal vein and frozen until analyzed for NEFA and glucose content.

Results and Discussion

Addition of 3 lb of top-dressed long-stem alfalfa hay increased dietary alfalfa hay (% of dry matter) from 22% to 25.8% and 24.8% for TMR + A and TMR +A + C, respectively. Dry-rolled corn constituted 27% of diet dry matter in TMR + A + C versus 29% in the control diet. Initial

body weights (BW) and body condition scores (BCS) are summarized in Table 2. The BCS were greater from primiparous cows than for multiparous cows. Loss in BW and BCS during the first 30 days postpartum was slightly greater for cows consuming only the TMR. Daily dry matter intake per cow receiving TMR, TMR + A, and TMR + A + C diets was estimated to by 37.8, 32.3, and 33.4 lb, respectively.

Lactation Performance. Multiparous cows produced more milk and EMC than primiparous cows (Table 2), but differences among dietary treatments were not detected. Concentrations of fat, protein, and solids-not-fat in milk were similar across diets, but concentrations of lactose were greater in cows consuming diet TMR + A than for those consuming the basal TMR or diet TMR + A + C.

Milk urea nitrogen and somatic cell count (SCC) did not differ among dietary treatments. Clinical ketosis was indicated when the beta-hydroxy butyric acid (BHBA) concentrations in milk were >1,000 μmol L^{-1}. Concentration of BHBA in the milk of primiparous cows did not differ among treatments and increased in all cows, regardless of dietary treatment, from day 1 to day 5. Milk from multiparous cows consuming diet A contained more BHBA than milk from cows consuming TMR, but was not different from the TMR + A + C diet. Concentrations of BHBA were similar on days 1, 3, 4, and 5 among treatments for multiparous cows (Figures 1 and 2).

Plasma Constituents. Top dressed long-stem alfalfa hay with or without dry-rolled corn did not alter blood concentrations of nonesterified fatty acids (NEFA) in primiparous cows (Figure 3), but top dressed long-stem alfalfa hay increased blood NEFAs in multiparous cows on days 2 and 3, compared to cows consuming TMR, and on day 2 compared to cows consuming TMR + A + C (Figure 4). Glucose concentration in plasma indicated similar responses to treatments between parity groups. Primiparous cows had greater plasma glucose than multiparous cows on days 1, 2, 3, and 5 (Figure 5). The basal TMR top dressed with alfalfa hay increased plasma glucose on day 4 in primiparous cows compared to those offered only the TMR, but not in those offered TMR + A + C (Figure 5). Plasma glucose concentrations were greater in multiparous cows offered TMR on the first day of lactation compared to those offered TMR + A + C, but no differences were observed among dietary treatments during days 2 through 5 of lactation (Figure 6). Rumen contractions in early lactating dairy cows provide an indication of rumen function. Rumen contractions were similar among diets (Figure 7) and were greater for multiparous than for primiparous cows.

Health Disorders. Incidences of health disorders are summarized in Table 3. Two primiparous cows consuming the basal TMR diet were diagnosed with displaced abomasums (DA) on the 19th and 30th days of lactation. Each cow also was diagnosed with metritis, which can contribute to the occurrence of DA's. Primiparous cows consuming diets TMR + A or TMR + A + C had one incidence of DA on days 10 and 11, respectively. The DA's in these two heifers likely resulted from reduced intake and lack of rumen fill, but relocation of 2-year-old cows on day 6 also may have contributed to its occurrence. Multiparous cows consuming the TMR had no incidences of DA during this study. Multiparous cows consuming diet

TMR + A had two DA's, one on day 9 and the other on day 10. One of these cows also experienced a retained placenta. One multiparous cow consuming diet TMR + A + C was diagnosed with a DA on the 16th day of lactation without other complications. Although commingling of cows might influence the incidence of DA's, inclusion of long-stem alfalfa hay did not reduce the incidence of DA because two primiparous and two multiparous cows receiving diets TMR + A and TMR + A + C developed DA's without other complications associated with the transition.

Ketosis has a profound negative effect on milk production in lactating dairy cattle. Losses in milk yield for a 305-day lactation can exceed 1,200 lb. In the present study, no cows were diagnosed with clinical ketosis based on use of Ketolac strips. Three cows were diagnosed with subclinical ketosis: one primiparous cow on the basal TMR diet, one on the TMR + A + C diet, and one multiparous cow on the TMR + A + C diet.

Conclusions

Top dressing a basal TMR diet containing at least 20% chopped alfalfa hay with long-stem alfalfa hay with or without additional dry-rolled corn during the first 5 days in milk supported lactation, but did not reduce the incidence of metabolic disorders.

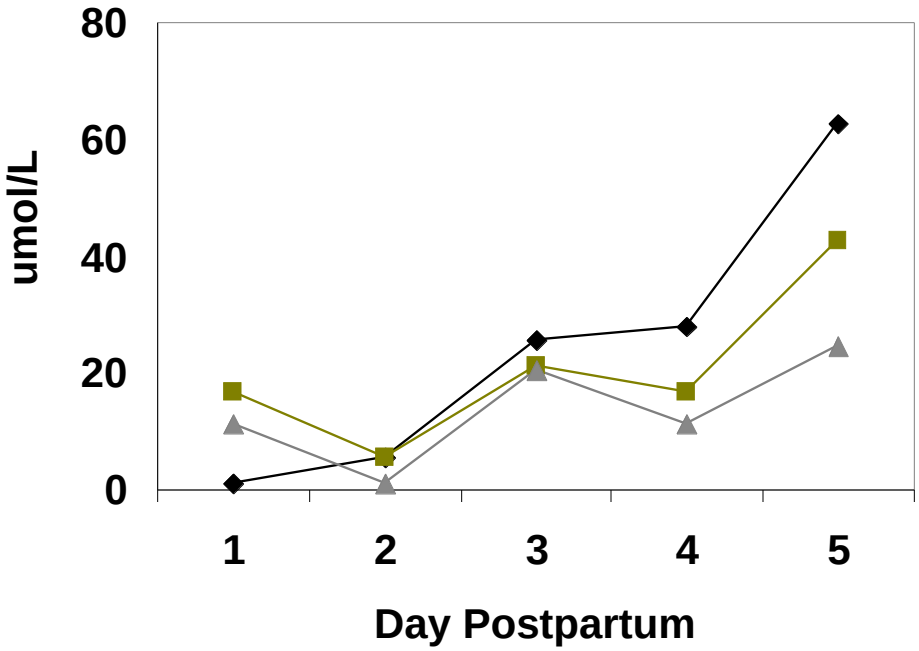

Figure 1. Beta-hydroxybutyric Acid Content in Milk from Primiparous Cows Fed TMR (◆), A (■), or A + C (▲).

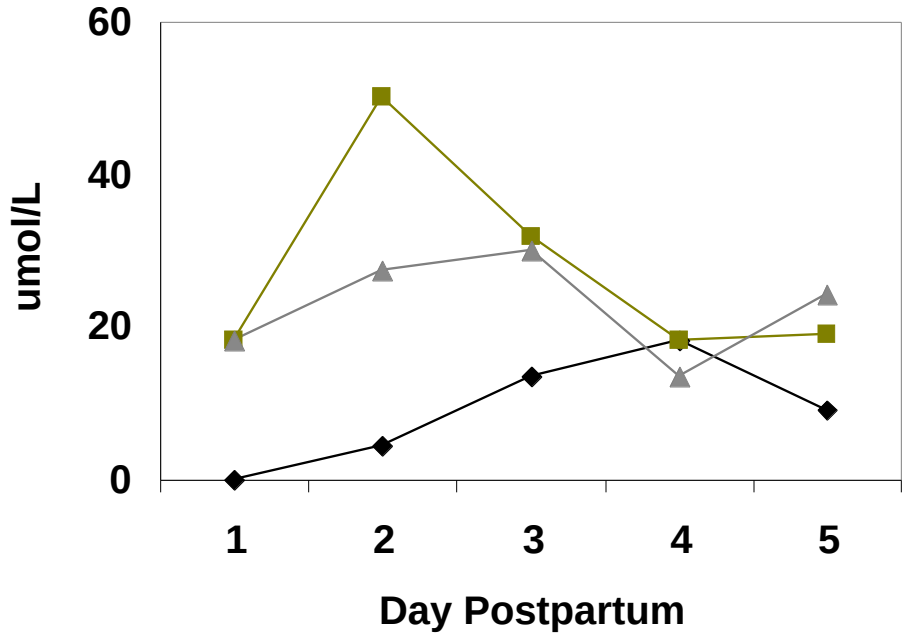

Figure 2. Beta-hydroxybutiric Acid Content in Milk from Multiparous Cows Fed TMR (◆), A (■), or A + C (▲).

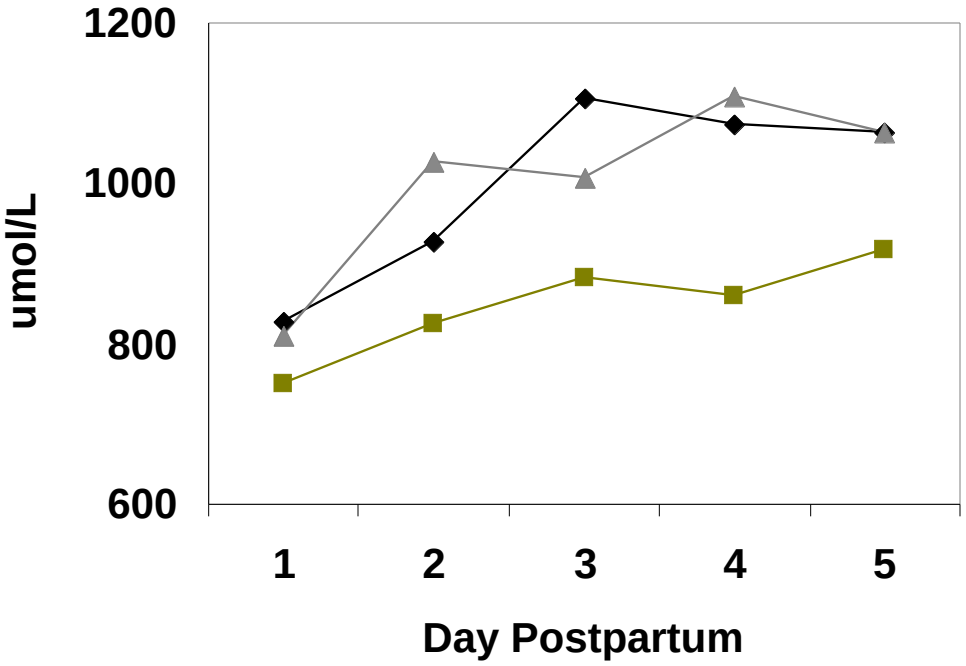

Figure 3. Plasma NEFA Concentration for Primiparous Cows fed TMR (◆), A (■), or A + C (▲).

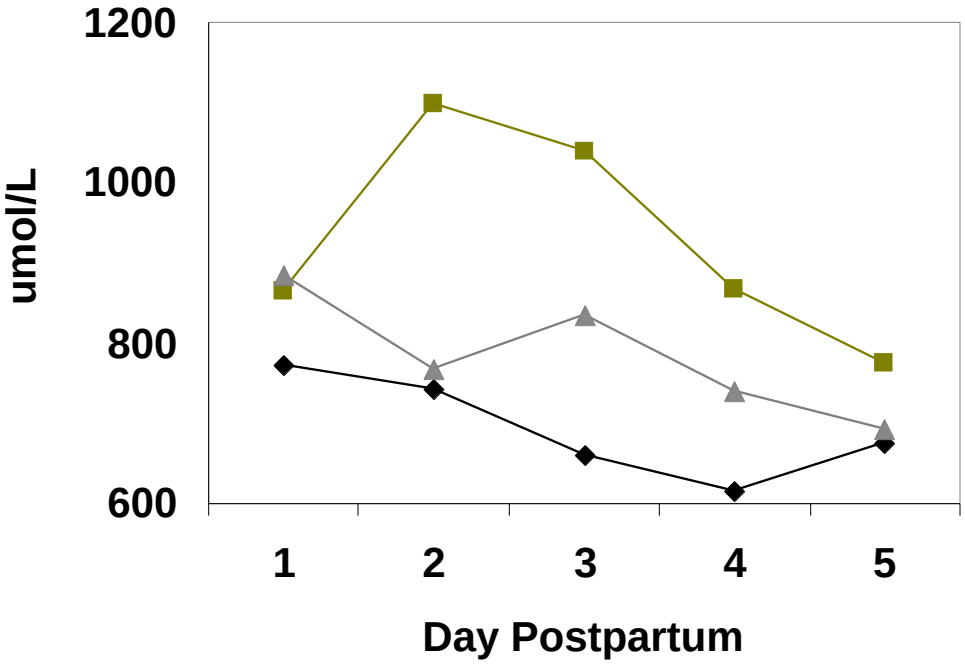

Figure 4. Plasma NEFA Concentration for Multiparous Cows fed TMR (◆), A (■), or A + C (▲).

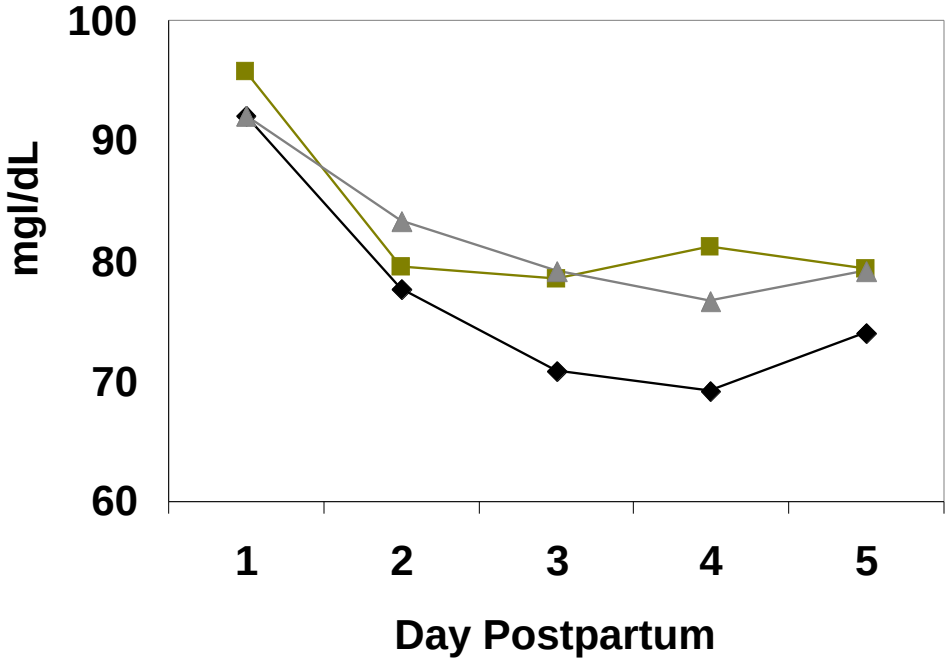

Figure 5. Plasma Glucose Concentration for Primiparous Cows Fed TMR (◆), A (■), or A + C (▲).

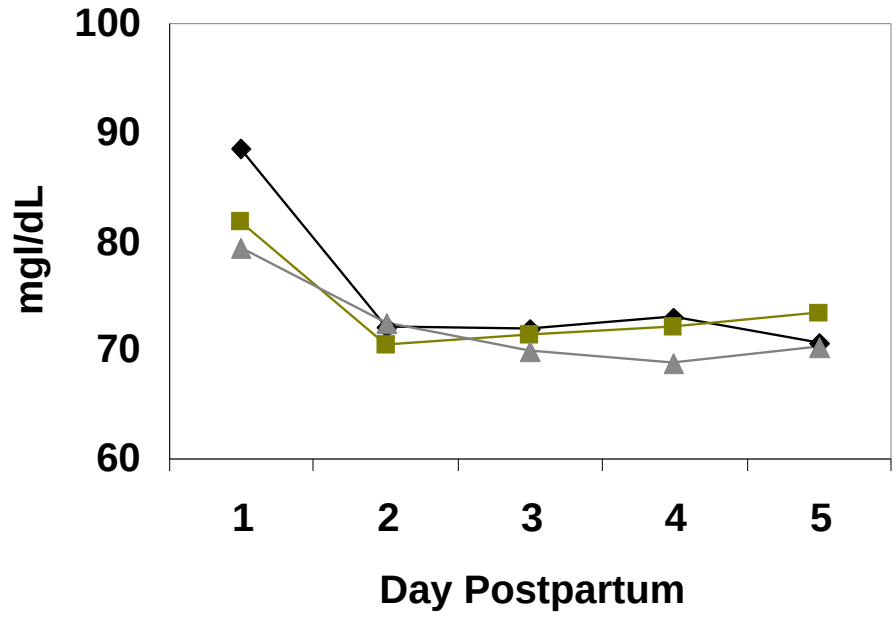

Figure 6. Plasma Glucose Concentration for Multiparous Cows Fed TMR (◆), A (■), or A + C (▲).

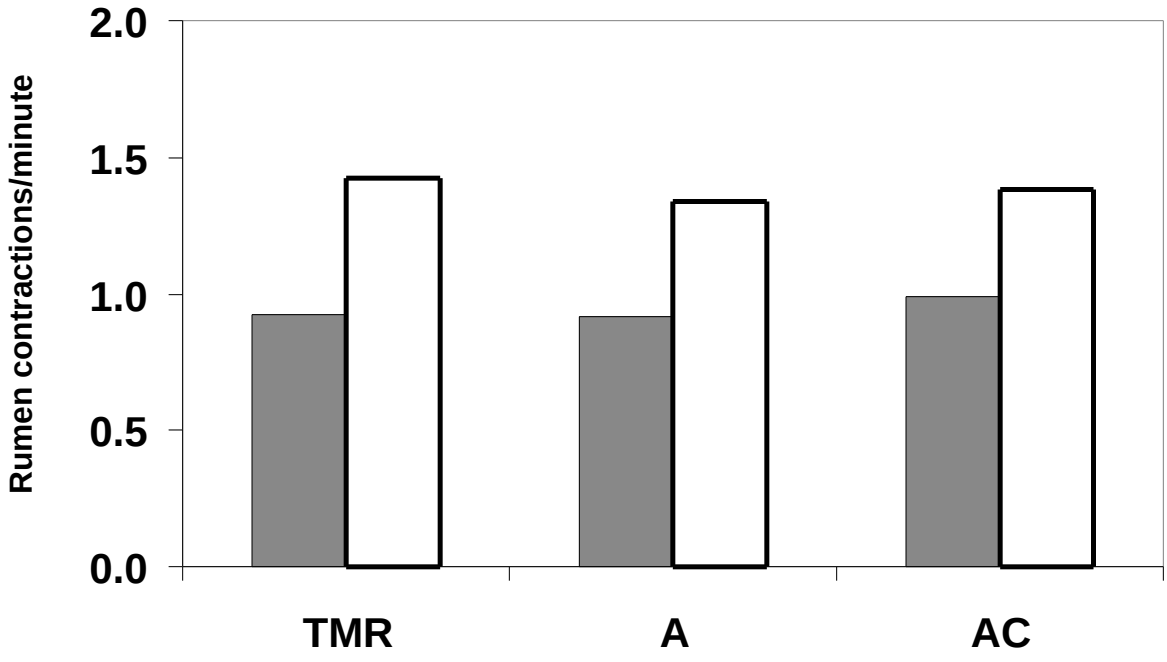

Figure 7. Rumen Contractions for Primiparous (■) and Multiparous (□) cows.

Table 1. Ingredient and Chemical Composition of Experimental Diets

	Diet[1]		
Ingredient	TMR	TMR + A	TMR + A + C
	----------% of dry matter ----------		
Alfalfa hay	22.0	25.8	24.8
Corn, dry-rolled	27.4	26.1	29.5
Corn silage	10.0	9.5	9.0
Wet corn gluten feed	20.0	19.0	18.1
Whole cottonseed	9.0	8.6	8.1
Soybean meal, expeller	7.1	6.8	6.4
Fishmeal	1.3	1.2	1.2
Molasses	1.2	1.1	1.1
Sodium bicarbonate	0.69	0.65	0.62
Limestone	0.64	0.61	0.58
Trace mineralized salt[2]	0.29	0.28	0.26
Magnesium oxide	0.20	0.19	0.18
Vitamin ADE premix[3]	0.12	0.11	0.11
Zinpro	0.05	0.05	0.05
Sodium selenite premix[4]	0.01	0.01	0.01
Nutrient			
CP, %	20.2	20.3	19.8
NDF, %	29.8	30.2	29.3
ADF, %	17.6	18.3	17.6
NFC, %	41.6	41.0	42.7
NE_L[5], Mcal/kg	1.68	1.68	1.68
Calcium, %	1.0	1.0	0.9
Phosphorus, %	0.5	0.5	0.5

[1]Basal TMR= total mixed ration, TMR + A = TMR + 3 lb of top dressed long-stem alfalfa hay, TMR + A + C = TMR + 3 lb of top dressed long-stem alfalfa hay + 3 lb of top dressed dry-rolled corn.

[2]Composition not less than: 95.5% NaCl, 0.24% Mn, 0.24% Fe, 0.05% Mg, 0.032% Cu, 0.032% Zn, 0.007% I, 0.004% Co.

[3]Formulated to contain 5,733 IU of vitamin A, 2,866 IU of vitamin D, and 17 IU of vitamin E.

[4]Formulated to contain 1,323 mg Se per lb.

[5]National Research Council (2001).

Table 2. Lactation Performance of Cows During the First 30 Days in Milk

	Primiparous			Multiparous			
Item	TMR[1]	TMR + A	TMR + AC	TMR	TMR + A	TMR + AC	SEM[1]
No. of cows	9	9	9	10	11	11	
Milk, lbs/day[a]	57.6	60.9	55.0	87.3	91.3	84.5	4.6
ECM[2], lbs/day[a]	67.8	71.1	63.4	93.5	98.6	92.4	5.3
Milk fat, %[a]	4.91	4.74	4.66	3.82	4.16	4.27	0.21
Milk protein, %	3.10	3.26	3.26	3.24	3.22	3.22	0.10
Milk lactose, %[b]	4.72	4.96	4.85	4.70	4.91	4.72	0.08
Milk SNF, %	8.73	9.17	9.03	8.89	9.03	8.84	0.17
Milk fat, lb/day[a]	2.8	2.8	2.5	3.4	3.7	3.5	0.2
Milk protein, lb/day[a]	1.8	2.0	1.8	2.9	2.9	2.7	0.2
Milk lactose, lb/day[a]	2.7	3.0	2.7	4.1	4.5	4.0	0.2
SCC[3], × 1000	79	93	208	212	125	196	71
Milk urea N, mg/dl[a]	13.4	12.9	12.7	14.8	15.4	14.5	0.77
No. of cows	9	9	9	11	11	11	
Initial BW, lb[a]	1344	1338	1338	1597	1588	1584	26.2
BW change, lb	-169	-101	-119	-191	-103	-112	13.0
Initial BCS[a]	3.33	3.30	3.30	2.82	2.64	2.73	0.12
BCS change	-0.82	-0.33	-0.64	-0.50	-0.30	-0.37	0.15

[1]Basal TMR = total mixed ration, TMR + A = TMR + 3 lb of top dressed alfalfa hay; and TMR + A + C = TMR + 3 lb of top dressed alfalfa hay + 3 of top dressed dry-rolled corn.

[2]Energy corrected milk.

[3]Somatic cell count.

[a]Effect of parity ($P<0.05$).

[b]Effect of treatment ($P<0.05$): TMR + A >TMR + AC and basal TMR: TMR + AC = TMR.

Table 3. Incidence of Health Disorders for Cows During the First 30 Days in Milk

	Primiparous			Multiparous		
Item	TMR[1]	A	AC	TMR	A	AC
No. of cows	9	9	9	10	11	11
Displaced abomasum	2	1	1	0	2	1
Day of incidence	19,30	10	11	-	9,10	16
Clinical ketosis[2]	0	0	0	0	0	0
Subclinical ketosis[3]	1	0	1	0	0	1
Retained placenta	0	0	0	0	1	0
Metritis	2	0	0	0	0	0

[1]Basal TMR = total mixed ration; TMR + A = TMR + 3 lb of top dressed alfalfa hay; and TMR + A + C = TMR + 3 lb of top dressed alfalfa hay + 3 lb of top dressed dry-rolled corn.

[2]Clinical ketosis: Concentrations of beta-dydroxy butyric acid (BHBA) >1000 µmol/L in milk.

[3]Subclinical ketosis: BHBA > 200 µmol/L in milk.