# Effect of Backgrounding Diet on Subsequent Performance of Growing Calves Grazing Tall Fescue[1].

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## Story in Brief

During the fall of 1999, 96 calves were backgrounded in dry-lot for 68 d to determine the effect of diet on subsequent performance of cattle grazing cool-season pasture. Two treatments were program-fed high-concentrate diets with either liquid molasses-based or oil-seed meal-based protein supplement and the other two treatments were fed hay and supplemented with rice bran or a self-fed liquid molasses-based supplement (2 x 2 factorial). After the dry-lot phase, there were no differences ($P > 0.05$) in BW, although hay-fed calves supplemented with liquid supplement had lower ($P < 0.05$) ADG than the other treatments. Dry-lot cost of gain was higher ($P < 0.05$) with hay-based diets or with liquid supplemented diets. During the first 14 d of the grazing period, program-fed calves gained 1.61 lb/d more ($P < 0.05$) than hay-fed calves. The inclusion of liquid supplements improved ($P < 0.05$) performance by 0.50 lb/d during the initial 14 d of grazing. Grazing performance after the first 14-d period was not effected ($P > 0.05$) by previous dry-lot diet, but profitability was improved by approximately $18.50 per animal by programmed-feeding. Forage digestibility and ruminal pH on pasture was not affected ($P > 0.05$) by dry-lot diet beyond d 6 of grazing.

## Introduction

In order to improve the profitability of cattle production, weaned calves need to be retained through subsequent stages of production. Because of a seasonal shortage of high-quality forages after weaning, calves are often backgrounded in dry-lot before high-quality pasture is available. The growth of stocker cattle will often "stall" for up to 30 d after being switched from dry-lot diets to pasture. Lippke et al. (2000) observed a negative relationship between the magnitude of change in the ruminal acetate:propionate ratio and the ADG of calves in the first 7 d of grazing when placed on immature wheat pasture. They suggested that this decrease in the ruminal acetate:propionate ratio might indicate digestive upset as a cause of poor initial grazing performance (Lippke et al., 2000). Lippke and Warrington (1984) used purified diets formulated to simulate the fiber, protein, and carbohydrate fractions that are commonly found in annual ryegrass and found ruminal acidosis conditions in calves in the first 8 d of feeding. Also, research at our facility has shown that programmed feeding of calves high-concentrate diets is an economic alternative to feeding hay (Beck et al., 2000). Initial daily gains of growing cattle grazing either fescue or winter-annual pastures (wheat, rye and ryegrass) were 0.6 lb/d lower ($P < .05$) for cattle having been fed hay and supplement than cattle that had been program fed a high-concentrate diet.

The purpose of these following experiments was to evaluate the use of four dry-lot diets on ruminal digestion and subsequent performance of beef cattle grazing stockpiled tall fescue pasture.

## Materials and Methods

*Performance Trial.* On October 14, 1999, 96 weaned calves from the University of Arkansas Southwest Research and Extension Center cowherd were divided into four treatments with two replications per treatment (eight groups). In order to test the effect of different backgrounding diets on subsequent grazing performance, two treatments were fed bermudagrass hay with either a rice bran based supplement (DRY) or a molasses-based liquid supplement (MOL) that was self fed. Two treatments were program-fed (as defined by Galyean, 1999) a high-concentrate diet with either a dry-protein supplement (CON) or molasses-based protein supplement (CONMOL). The composition of the program-fed diets is shown in Table 1. Adjustments were made to feeding levels of diets throughout the backgrounding period in order to maintain similar animal ADG among treatments. Rice bran was used as the dry supplement for DRY diets and was analyzed to contained 15.3% CP, 0.86 Mcal NEm/lb and 0.57 Mcal NEg/lb. Rice bran normally contains around 12 to 15% fat, when program-fed calves exhibited signs of excess fat in the diet the rice bran was analyzed for fat concentration and found to contain 21% fat. Rice bran concentration was reduced in the program-fed diets from 44.9 and 36.6% to 22.5 and 18.75% for CON and CONMOL, respectively at d 47 on feed. Hay was analyzed to contain 11% CP, 0.44 Mcal NEm/lb and 0.20 Mcal NEg/lb. The molasses-based supplement was offered free choice in lick-wheel tanks and the concentration of protein and phosphorus were adjusted to maintain the desired level of intake. The initial liquid supplement contained 18% CP, 49% TDN, 1% P and 60% DM

(as-fed basis). When excessive liquid supplement amounts were consumed the protein concentration was increased to 26% (as-fed basis).

One hundred acres of fall growth tall fescue (Kentucky-31) were stockpiled from October 1 until December 21 by restricting grazing and fertilizing with 50 lb of nitrogen/acre the first week of October as described by Gerrish et al. (1993). During the winter grazing period, pastures consisted primarily of tall fescue (76%), cool-season annual grasses (15%), and volunteer annual ryegrass (7%). Forage availability was measured by rising plate meter in mid-January and mid-March. Average forage DM availability was 2,961 lb/acre in January and 2,326 lb/acre in March.

On December 21, the calves were removed from dry-lot, shrunk for 16-hours, weighed, and placed on pasture. The calves were allocated to pastures stratified by treatment, so each treatment was equally represented in each pasture. Calf weights were recorded after the first 14 d of grazing and at 28- to 35-d intervals there after (16-hour shrink). In late January, near record snowfall amounts were recorded (19"), which restricted grazing for nearly 10 d, during this time bermudagrass hay was fed to the calves while they remained pasture. On February 8, calves in four pastures were given access to liquid molasses-based supplements in lick-wheel type feeders in order to test the effect of liquid supplements on performance of growing calves grazing spring re-growth fescue. The initial liquid supplement contained 18% CP, 49% TDN, 1% P, and 60% DM (as-fed basis). When excessive liquid supplement levels were consumed the protein concentration was increased to 26% (as-fed basis).

The effect of backgrounding treatment during the dry-lot and grazing periods were analyzed by ANOVA using PROC GLM of SAS (1991) as a completely randomized design with a 2 x 2 factorial arrangement of treatments. Dry-lot pens were considered the experimental unit, so treatment effects were tested with pen within treatment as the error term. Effect of dry-lot diets for the dry-lot phase and grazing phase were separated using contrasts (Steel and Torrie, 1980). The backgrounding treatment by pasture supplementation treatment interaction was not significant ($P > 0.25$), so only the effects of backgrounding treatments are discussed. The University of Arkansas Institutional Animal Care and Use Committee (Protocol No. 98012) approved all animal procedures conducted and all procedures agree with guidelines recommended by the Consortium (1988).

*Economic Analysis.* Cost analysis for the backgrounding treatments, assumed $85.00/ton hay, which is based on the average current cost of high-quality grass hay including transportation cost, $106.00/ton corn, $78.00/ton rice bran, $200.00/ton liquid supplement, a $10.00/ton milling charge and $0.30/animal daily charge for management, labor, and other overhead. The cost of feed ingredients was based on the 10-year average price of corn ($2.41/bushel). The current price relationship between corn and byproduct feeds, plus a transportation cost of $10.00/ton and a $20.00/ton distributor markup was used to estimate the cost of the byproducts used in the trials. For the economic analysis, program-fed diets were calculated to cost $110.00/ton for CON, $120.00/ton for CONMOL. The supplements used were assumed to cost

$150.00 for DRY and $200.00 for MOL based on retail cost of comparable supplements.

The break-even analysis and determination of enterprise profitability was calculated by subtracting cost of gain from a $79.00/cwt value of gain then multiplying by amount of gain. Value of gain was determined using the 10-year average price at Oklahoma City National Stockyards of a 400 lb steer in September ($85.86/cwt) and a 665 lb feeder steer in April ($83.12/cwt).

*Digestion Trial.* A randomized complete block design experiment was conducted using eight steers fitted with ruminal cannulae in each block. The steers used in Block 1 had an average BW of 1,179 lb, and steers in Block 2 had an average BW of 735 lb. The steers were fed to an equal percentage of BW (2.3% of BW for program-fed diets, and 0.46% of BW for DRY; DM basis) as corresponded to calves in the performance trial. Two steers were assigned to each of the four dry-lot diets (Table 1) for 21-d (Block 1) and 31-d (Block 2), long-stem bermudagrass hay was fed for the first 7 d in order to acclimatize the calves to programmed-feeding. After the dry-lot period, steers grazed stockpiled tall fescue for a 27-d sampling period.

Vegetative stockpiled tall fescue forage was collected on December 8, 1999. The forage sample was dried in a forced-air oven at 140° F. Forage was spread less than .4 inches deep and turned every 6 h until dry to prevent artifact lignin formation (Broesder et al., 1992). Dried forage was then ground to pass a 2-mm screen in a Willey Mill. Adequate forage was collected so the same forage was used with both blocks in the digestion study. Nylon bags containing

approximately 2 g of the ground forage were incubated for 24-h on d -1, 0, 3, 6, 9, 14, 20, and 27 of the grazing (sampling) period. Samples of ruminal contents (250 ml) were collected at 0800, 1200, 1600, and 2000 hours on d -1, 3, 9, 16, 20, and 27 and were immediately analyzed for pH using a combination electrode.

Data were analyzed by ANOVA as a completely-randomized design with a split-plot in time using SAS (1991). The model included backgrounding diet, block, time, block x backgrounding diet, time x backgrounding diet, and block x time within backgrounding diet (Lentner and Bishop, 1986). The effects of block and backgrounding diet were tested with the interaction of block x time. Least-squares means were separated using the least significant difference procedure (Steel and Torrie, 1980).

## Results and Discussion

*Performance Trial.* The performance of calves during the dry-lot phase is shown in Table 2. After the dry-lot phase, treatment had no effect ($P = 0.10$) on BW, although calves on hay based diets tended to be slightly lighter ($P = 0.08$) than program-fed calves. The ADG of calves during dry-lot was lower for calves fed hay-based diets compared to program-fed calves ($P = 0.04$). This difference is the result of a tendency for lower ($P < 0.09$) performance of MOL calves compared to DRY, CON, and CONMOL. This lower performance may have been the result of the low energy content of the hay (0.44 Mcal NEm/lb) used in this trial, which the liquid supplement could not adequately compensate for at the desired level of consumption.

The performance of calves after the beginning of grazing on stockpiled tall fescue is shown in Table 3. The backgrounding diet x pasture supplementation interaction was not significant ($P > 0.25$), so only the backgrounding effects are discussed in this paper. During the first 14-d of the grazing period, calves from hay-based treatments lost ($P < 0.05$) BW. Calves from program-fed treatments gained ($P < 0.05$) BW resulting in a net increase ($P < 0.01$) in ADG of 1.61 lb/d compared to hay-fed calves. The calves fed liquid-based supplement gained 0.50 lb/d more ($P = 0.01$) than calves fed dry-protein supplements. Body weight of program-fed calves was higher ($P < 0.06$) than calves fed hay-based diets at the end of the first 14-d grazing period and at the end of grazing phase in April (Table 3). Dry-lot diets had no effect ($P = 0.52$) on overall pasture ADG, but program-fed calves held a numerical advantage of 0.13 lb/d over hay-fed calves.

The profitability of the stocker cattle enterprise was improved ($P < 0.05$) by an average of $18.50/animal by programmed-feeding. The observations from this trial closely resemble those found by Beck et al. (2000), who showed that the programmed-feeding of calves corn/corn gluten feed based diets improved early season grazing performance and overall profitability of the stocker cattle enterprise compared to backgrounding with hay-based diets.

Part of the advantage in initial pasture ADG by program-fed calves may be explained by differences in gut fill. The passage rate of high-roughage diets in DRY and MOL treatments would be slower than program-fed high-concentrate diets and differences in fill would likely occur in the initial pasture BW, even after a over-night shrink. The improved ($P < 0.05$) performance of the MOL and

CONMOL calves during the initial 2-week grazing period (Table 3) clearly show that fill differences are not completely responsible for the differences in initial BW gain on pasture. This increase in initial pasture ADG indicates that program-feeding high-concentrate diets or the addition of a molasses-based liquid supplement to either hay- or concentrate-based diets probably alters the ruminal environment to more effectively digest the high concentrations of soluble carbohydrate, ammonia-N, and degradable protein fractions found in vegetative cool-season grasses. Lippke et al. (2000) observed a negative relationship between the magnitude of change in the ruminal acetate:propionate ratio and ADG of calves in the first 7 d of grazing when placed on immature wheat pasture. They suggested that this decrease in the ruminal acetate:propionate ratio might indicate digestive upset as a cause of poor initial grazing performance (Lippke et al., 2000). Also, Lippke and Warrington (1984) used purified diets formulated to simulate the fiber, protein, and carbohydrate fractions that are commonly found in annual ryegrass and found ruminal acidosis conditions in calves in the first 8 d of feeding. When selecting a backgrounding diet formulation, it may be possible to pre-condition the rumen to quickly adapt to the cool-season pasture diet and prevent the potential for digestive upset, resulting in improved animal performance.

*Digestion Trial.* The forage samples incubated in situ were 10 to 15 percentage units lower ($P < 0.05$) in dry matter disappearance (DMD) on d -1 and 0 in program-fed calves compared to hay-fed calves (Table 4). By d 3 of grazing, in situ forage DMD in CON fed calves did not differ ($P > 0.05$) from hay-fed

calves, and forage incubated in CONMOL calves was 4.0 to 5.5 percentage units lower ($P < 0.05$) in DMD than hay-fed calves. There were no differences ($P > 0.05$) in DMD as a result of dry-lot diet during grazing on d 6, 9, 14, or 27. On d 20, CON had higher ($P < 0.05$) DMD than other treatments (79.1 vs 76.9, 73.8, or 74.0; CON vs DRY, MOL, or CONMOL, respectively). In situ DMD for DRY and MOL tended to increase ($P < 0.13$) from d -1 and 0, until d 3 then remained stable until d 9 then declined through d 27 ($P < 0.07$). Program-fed diets had the lowest ($P < 0.05$) DMD on d -1 and 0, but rapidly increased ($P < 0.05$) on d 3 and remained high through d 27, except for CONMOL, which had a lower ($P < 0.05$) extent of DMD on d 20.

Ruminal pH was lower ($P < 0.05$) for program-fed calves than calves fed hay on d -1 (Table 5). On d 3, CONMOL calves had higher ($P < 0.05$) ruminal pH than other treatments (6.98 vs 6.62, 6.80, and 6.76; for DRY, MOL, and CON, respectively). Ruminal pH was not affected ($P > 0.05$) by dry-lot diet on d 9, 16, 20, or 27. Ruminal pH was increased ($P < 0.05$) in program-fed calves by d 3. Ruminal pH did not differ ($P > 0.05$) among backgrounding diets through d 9. On d 16, all backgrounding diets displayed a marked decrease ($P < 0.05$) in ruminal pH compared to d 9. On d 20 and 27 ruminal pH levels began to slowly increase with pH tending to be higher ($P < .06$) than on d 16 by d 27. The decrease in ruminal pH seen on d 16 in all backgrounding diets corresponds with the tendency ($P < 0.16$) for a decrease in the extent of DMD noted on d 14 for CON and a decrease ($P < 0.05$) in the extent of DMD noted on d 20 for DRY, MOL and CONMOL. These changes in ruminal pH and extent of DMD may indicate there

was a slight alteration in ruminal function, which decreases the ability of ruminal microflora to breakdown forage dry matter. With roughage diets, slow and gradual enzymatic hydrolysis of fiber sets the pace for fermentation and controls the release of easily degraded cell contents (Schwartz and Gilchrist, 1975). Under these conditions, ruminal pH effectively controls the composition of ruminal microflora. Most ruminal microbes thrive when pH exceeds 6.5. In contrast, with high intakes of low-fiber forages pH is typically below 6 intermittently or continuously (Owens and Goetsch, 1988). In this study on d 16, ruminal pH averaged 6.0 across all backgrounding diets (Table 5). Hence, the ruminal environment did spend a good portion of the day below a pH of 6.0 during this time period, which would have decreased fiber digestion (Hoover et al., 1984).

The large improvement in early pasture performance with programmed feeding or liquid feed additions cannot be fully explained by the changes in ruminal pH or extent of DMD. There may be changes in VFA production or acetate:propionate ratio exerting an effect, similar to the findings by Lippke et al. (2000) that can shed light on these changes in production.

## Implications

Diets fed to calves during backgrounding in dry-lot before grazing does influence performance early in the grazing season. The addition of molasses-based supplements to the backgrounding diets can improve performance immediately after the initiation of grazing by as much a 0.50 lb/d and programmed-feeding improved performance during the same period by as

much as 1.61 lb/d. Programmed-feeding of growing cattle improves feed efficiency and decreases feed costs. Any decrease in forage digestibility caused by programmed-feeding has little carryover past d 3 of the grazing period.

## Literature Cited


Beck, P., S. Gunter, K. Cassida, and M. Phillips. 2000. Diet and pattern of gain of weaned calves affects subsequent performance on grass. Arkansas Anim. Sci., 1999 Dept. Rep. RS-470:102-106.

Broesder, J. T., S. A. Gunter, L. J. Krysl, and M. B. Judkins. 1992. Digestion of ruminal masticate dried by three different methods. Anim. Feed Sci. Tech. 37:323-331.

Consortium. 1988. Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. Consortium for Developing a Guide for the Care and Use of Agricultural Animals in Agricultural Research and Training. Champaign, IL.

Gerrish, J. M., P. R. Peterson, C. A. Roberts, and J. R. Brown. 1993. Rate and timing of nitrogen fertilization impact yield and quality of stockpiled tall fescue. Proc. 1993 Amer. Forage and Grassl. Council Meetings. Vol. 2; pp. 165-169.

Galyean, M. L. 1999. Review: restricted and programmed feeding of beef cattle-definitions, applications, and research results. Prof. Anim. Sci. 15:1-6.

Hoover, W. H., C. R. Kincaid, G. A. Varga, W. V. Thayne, and L. L. Junkins, Jr. 1984. Effects of solids and liquid flows on fermentation in continuous cultures. IV. pH and dilution rate. J. Anim. Sci. 58:692-699.

Lentner, M., and T. Bishop. 1986. Experimental Design and Analysis. Valley Book Co., Blacksburgs, VA.

Lippke, H., T.D.A. Forbes, and W. C. Ellis. 2000. Effect of supplements on growth and forage intake by stocker steers grazing wheat pasture. J. Anim. Sci. 78:1625-1635.

Lippke, H., and B. G. Warrington. 1984. Influence of digestible and indigestible fibers in forage-based, semi-purified diets on intake and ruminal acid concentrations. J. Dairy Sci. 67(Suppl. 1):136 (Abstr.).

Owens, F. N., and A. L. Goetsch. 1988. Ruminal fermentation. In: D. C. Church (Ed.). The Ruminant Animal: Digestion, Physiology, and Nutrition. Prentice Hall, Englewood Cliffs, NJ.

SAS. 1988. SAS® User's Guide: Statistics (Version 6th Ed.). SAS Inst. Inc., Cary, NC.

Schwartz, H. M., and F.M.C. Gilchrist. 1975. Microbial interactions with the diet and host animal. In: I. W. McDonald and A.C.I. Warner (Eds.). Digestion and Metabolism in the Ruminants. pp 165. Univ. New England Publ. Unit. Armidale, NSW, Australia.

Steel, R.G.D., and J. H. Torrie. 1980. Principles and Procedures of Statistics: A Biometrical Approach. MacGraw-Hill Book Co. New York.

Table 1. Composition of program-fed diets used during dry-lot period

| Ingredient | CON I[a] | CON II | CONMOL I | CONMOL II |
|---|---|---|---|---|
| | ----------% DM---------- | | | |
| Rice bran | 42.8 | 22.7 | 38.9 | 18.9 |
| Corn | 42.3 | 61.9 | 38.9 | 58.9 |
| QLF 34/6[b] | - | - | 9.0 | 9.0 |
| Cottonseed hulls | 10.0 | 10.0 | 10.0 | 10.0 |
| Urea | 1.3 | 1.8 | - | - |
| Mineral premix | 3.6 | 3.6 | 3.2 | 3.2 |
| Composition | | | | |
| % Crude protein | 15 | 15 | 15 | 14 |
| NEm (mcal/lb) | 0.80 | 0.81 | 0.79 | 0.83 |
| NEg (Mcal/lb) | 0.52 | 0.53 | 0.51 | 0.54 |
| Percent fat | 12.4 | 8.5 | 10.8 | 7.2 |

[a]Diets fed before rice bran level was reduced in order to reduce fat content of diet is denoted with the roman numeral I and after rice bran level reduction denoted with II. CON treatment was program fed high concentrate diets without molasses based protein supplement. CONMOL treatment was program fed high concentrate diets including molasses based protein supplement.

[b]Quality Liquid Feed 34/6 – contains 34% crude protein (with 6% from natural protein sources), 0.51 mcal NEm/lb, 0.36 mcal NEg/lb, and 60% dry matter.

Table 2. Effect of dry-lot diet on performance and cost of backgrounding calves

| | Treatment[a] | | | |
|---|---|---|---|---|
| Item | DRY | MOL | CON | CONMOL |
| Body weight, lb | | | | |
| October 14, 1999 | 466 | 466 | 466 | 463 |
| December 21, 1999 | 551 | 535 | 553 | 552 |
| Average daily gain, lb/d[b] | 1.20 | 1.01 | 1.28 | 1.30 |
| Feed:gain, lb feed/lb gain[b] | 12.7 | 15.9 | 11.8 | 11.8 |
| Dry-lot cost, $/animal[bcd] | $74 | $74 | $71 | $76 |

[a]Dry-lot treatments: Calves were fed bermudagrass hay with either a rice bran based supplement (DRY) or a molasses-based self-fed liquid supplement (MOL) or were program-fed a high-concentrate diet with either a dry-protein supplement (CON) or molasses-based protein supplement (CONMOL)

[b]Contrast - Hay based diets vs program-fed ($P < 0.05$).

[c]Contrast - Dry diets vs liquid supplemented diets ($P < 0.05$).

[d]Contrast - Dry/liquid vs hay/program-fed Interaction ($P < 0.05$).

Table 3. Effect of dry-lot diet on subsequent performance of calves grazing stockpiled tall fescue

| Item | Treatment[a] | | | |
|---|---|---|---|---|
| | DRY | MOL | CON | CONMOL |
| Body weight, lb | | | | |
| December 21, 1999 | 551 | 535 | 553 | 552 |
| January 5, 2000[a] | 527 | 521 | 555 | 561 |
| April 4, 2000[a] | 659 | 648 | 676 | 679 |
| Pasture ADG | | | | |
| December 21 to January 5[bc] | -1.47 | -.97 | .14 | .64 |
| Overall ADG on pasture | 1.05 | 1.08 | 1.17 | 1.22 |
| Overall cost of gain, $/cwt[bc] | $65 | $71 | $61 | $63 |
| Gross margin[d], $/animal[b] | $34 | $21 | $46 | $46 |

[a]Dry-lot treatments: Calves were fed bermudagrass hay with either a rice bran based supplement (DRY) or a molasses-based self-fed liquid supplement (MOL) or were program-fed a high-concentrate diet with either a dry-protein supplement (CON) or molasses-based protein supplement (CONMOL)

[b]Contrast - Hay based diets vs program-fed ($P < 0.05$).

[c]Contrast - Dry diets vs liquid supplemented diets ($P < 0.05$).

[d]Calculated by subtracting cost of gain from a $79.00/cwt value of gain then multiplying the amount of gain. Value of gain was determined using the 10-year average price at Oklahoma City National Stockyards of 400 lb steers in September ($85.86/cwt) and 665 lb feeder steers in April ($83.12/cwt).

Table 4. Effect of dry-lot treatment on 24-hour in situ dry matter disappearance of fescue forage in steers grazing stockpiled tall fescue

| Dry-lot Treatment[a] | Grazing Day | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -1 | 0 | 3 | 6 | 9 | 14 | 20 | 27 |
| DRY | 78.8$^{bde}$ | 78.5$^{bde}$ | 81.0$^{bde}$ | 80.9$^{de}$ | 81.9$^{d}$ | 78.1$^{de}$ | 76.9$^{bce}$ | 78.2$^{de}$ |
| MOL | 77.2$^{be}$ | 78.8$^{bde}$ | 82.3$^{bd}$ | 81.2$^{d}$ | 81.4$^{d}$ | 77.6$^{e}$ | 73.8$^{cef}$ | 78.6$^{de}$ |
| CON | 67.1$^{ce}$ | 66.6$^{ce}$ | 79.9$^{bcd}$ | 81.9$^{d}$ | 81.5$^{d}$ | 78.5$^{d}$ | 79.1$^{bd}$ | 78.5$^{d}$ |
| CONMOL | 63.6$^{cf}$ | 65.8$^{cf}$ | 76.8$^{cde}$ | 80.7$^{c}$ | 80.8$^{d}$ | 77.9$^{d}$ | 74.0$^{ce}$ | 78.9$^{d}$ |

[a]Dry-lot treatments: Calves were fed bermudagrass hay with either a rice bran based supplement (DRY) or a molasses-based self-fed liquid supplement (MOL) or were program-fed a high-concentrate diet with either a dry-protein supplement (CON) or molasses-based protein supplement (CONMOL)

[bc]Least-square means within columns with differing superscripts differ ($P < 0.05$).

[def]Least-square means within rows with differing superscripts differ ($P< 0.05$).

Table 5. Effect of dry-lot treatment on rumen pH of steers grazing stockpiled tall fescue

| Dry-lot Treatment[a] | Grazing Day | | | | | |
|---|---|---|---|---|---|---|
| | -1 | 3 | 9 | 16 | 20 | 27 |
| DRY | 6.53[bd] | 6.62[cd] | 6.55[d] | 5.91[e] | 6.26[de] | 6.44[d] |
| MOL | 6.71[bd] | 6.80[cd] | 6.66[d] | 6.15[e] | 6.03[e] | 6.68[d] |
| CON | 5.92[cf] | 6.76[cd] | 6.55[d] | 6.00[ef] | 6.18[ef] | 6.46[de] |
| CONMOL | 5.93[cf] | 6.98[bd] | 6.51[e] | 6.02[f] | 6.18[ef] | 6.52[e] |

[a]Dry-lot treatments: Calves were fed bermudagrass hay with either a rice bran based supplement (DRY) or a molasses-based self-fed liquid supplement (MOL) or were program-fed a high-concentrate diet with either a dry-protein supplement (CON) or molasses-based protein supplement (CONMOL)

[bc]Least square means within columns with differing superscripts differ ($P < 0.05$).

[def]Least-square means within rows with differing superscripts differ ($P< 0.05$).