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Wet corn gluten feed, with or without solvent-extracted germ meal, can diminish subacute acidosis during grain adaptation and after overconsumption of a finishing diet when it replaces dry-rolled corn.

### Summary

*Dry matter intake and ruminal acid concentration were used to evaluate the influence of a dry-rolled corn (Control) and wet corn gluten feed diets (corn bran and steep liquor with distillers solubles, with or without solvent-extracted germ meal) on acidosis. Wet corn gluten feed without solvent-extracted germ meal promoted highest dry matter intake and daily minimum ruminal pH during grain adaptation. Control reduced intake and ruminal pH more than wet corn gluten feed diets, but increased propionate production. When solvent-extracted germ meal was included in wet corn gluten feed, intake was slightly reduced and ruminal pH was more variable.*

### Introduction

Wet corn gluten feed provides an alternative to corn as an energy source for finishing cattle. By replacing dietary starch from corn with highly digestible fiber, wet corn gluten feed can reduce the incidence and severity of acidosis and increase feed intake in finishing cattle. Solvent-extracted germ meal is a byproduct of corn oil production and may be included as a component of wet corn gluten feed. Previous research indicated solvent-extracted germ meal increases energy content of wet corn gluten feed (1999 Nebraska Beef Report, pp. 29-31), although its influence on acidosis has not been investigated.

The objective of our study was to evaluate wet corn gluten feed (corn bran and steep liquor with distillers solubles) with and without solvent-extracted germ meal relative to dry-rolled corn, as a means to reduce the potential for subacute acidosis in finishing cattle.

### Procedure

Ruminally fistulated calves (n = 3, 833 lb) and yearlings (n = 3, 1164 lb) were blocked by age and used in a replicated 3 x 3 Latin square design to evaluate the influence of diet on DM intake, ruminal pH, and ruminal VFA concentration. Treatments were: dry-rolled corn control (DRC), and either a 50:50 blend of dry corn bran and steep liquor with distillers solubles (WCGF), or 33% dry corn bran, 33% steep liquor with distillers solubles, and 33% solvent-extracted germ meal (GERM). The two byproduct blends were fed at 43% of the dietary DM, replacing 50% of dry-rolled corn in the final diets (Table 1).

Steers were tethered in metabolism stalls with individual feed bunks suspended from load cells, and equipped with ruminal pH electrodes. Load cells and pH electrodes were wired directly to a computer that recorded feed weight and ruminal pH every minute throughout each period.

Periods consisted of 28 days. On days 1 through 12, adaptation diets containing 45, 25, and 15% alfalfa hay were fed at 9 a.m. each for four days. From day 13 through 18, the 7.5%-alfalfa hay final diet was fed daily at 9 a.m. (prechallenge). Orts were collected daily at 8:30 a.m. Day 19 of each period initiated an acidosis challenge. Orts were collected at 8:30 a.m. and cattle received the 7.5%-forage diet, but feed was withheld until 1 p.m. and increased 25% above the previous day's weight in order to induce hunger and the potential for overconsumption. The acidosis challenge was designed to simulate a feedlot situation in which cattle were fed late, or otherwise prone to overeat due to being under-fed or changes in weather. The postchallenge phase began with the acidosis challenge at 1 p.m. on day 19. On days 20 through 23, cattle resumed the 9 a.m. feeding

**Table 1. Final diets fed to ruminally fistulated steers (% of DM)**

| | Treatment[a] | | |
|---|---|---|---|
| Item | DRC | WCGF | GERM |
| Dry-rolled corn | 85.47 | 42.92 | 43.12 |
| Dry corn bran | — | 21.51 | 14.34 |
| Solvent-extracted germ meal | — | — | 14.34 |
| Steep liquor/distillers solubles | — | 21.51 | 14.34 |
| Alfalfa hay | 7.50 | 7.50 | 7.50 |
| Molasses | 5.00 | 5.00 | 5.00 |
| Limestone | .93 | 1.18 | .98 |
| Dicalcium phosphate | .09 | — | — |
| Urea | .63 | — | — |
| Salt | .30 | .30 | .30 |
| Trace mineral premix[b] | .03 | .03 | .03 |
| Vitamin premix[c] | .02 | .02 | .02 |
| Rumensin[d] | .02 | .02 | .02 |
| Tylan[e] | .01 | .01 | .01 |

[a]DRC = dry-rolled corn control, WCGF = 50% dry corn bran and 50% steep liquor with distillers solubles, GERM = 33% dry corn bran, 33% steep liquor with distillers solubles, and 33% solvent-extracted germ meal (DM basis).
[b]10% Mg, 6% Zn, 4.5% Fe, 2% Mn, .5% Cu, .3% I, and .05% Co.
[c]15,000 IU of vitamin A, 3,000 IU of vitamin D, and 3.75 IU of vitamin E per g of premix.
[d]80 g monensin per lb of premix.
[e]40 g of tylosin per lb of premix.

**Table 2. Influence of treatment on measures of intake; dietary concentrate level analysis**

| | Treatment[a] | | | |
|---|---|---|---|---|
| Item | DRC | WCGF | GERM | SEM |
| DM intake, lb/d | 24.0[b] | 26.5[c] | 24.5[b] | .9 |
| Intake rate, %/hour | 19.3[d] | 16.3[e] | 19.3[d] | .8 |
| Total feeding time, min | 409.5[f] | 497.8[g] | 544.7[g] | 34.6 |
| Average feeding time, min | 45.8[b] | 50.0[b] | 58.0[c] | 3.7 |
| Maximum feeding time, min | 95.5[f] | 105.5[f] | 138.1[g] | 11.0 |
| Maximum meal, lb DM | 6.6 | 5.7 | 6.4 | .5 |

[a]DRC = dry-rolled corn control, WCGF = 50% dry corn bran and 50% steep liquor with distillers solubles, GERM = 33% dry corn bran, 33% steep liquor with distillers solubles, and 33% solvent-extracted germ meal (DM basis).
[bc]Means within row with unlike superscript differ ($P < .10$).
[de]Means within row with unlike superscript differ ($P < .01$).
[fg]Means within row with unlike superscript differ ($P < .05$).

time. During the last five days of each period, data were not collected and cattle were allowed ad libitum access to ground alfalfa hay. Corn milling byproducts were maintained at 43% of dietary DM in adaptation and final diets.

Ruminal fluid was sampled using a suction strainer before feeding (8:45 a.m.) on the third day following each increase in dietary concentrate and subsequently analyzed for VFA and lactate content.

Means were calculated for average and minimum ruminal pH, daily pH variance, and the area of ruminal pH < 5.6 (magnitude of ruminal pH < 5.6 by min) as an indication of subacute acidosis. Daily observations of feed weight were used to calculate total, maximum, and average feeding time (minutes/meal); maximum meal amount (lb/meal); and rate of intake.

To test treatment effects across levels of dietary concentrate, mean daily intake and ruminal pH data were averaged for day within adaptation and final diets for each animal. A separate analysis was conducted to determine the influence of acidosis challenge on subsequent intake and ruminal pH measures. For both analyses, data were analyzed as a replicated Latin square design with a split plot incorporating repeated measures using the Mixed procedure of SAS (1990). Least squares means were separated using a protected *t* test when a significant fixed-effect *F*-test ($P < .10$) was detected.

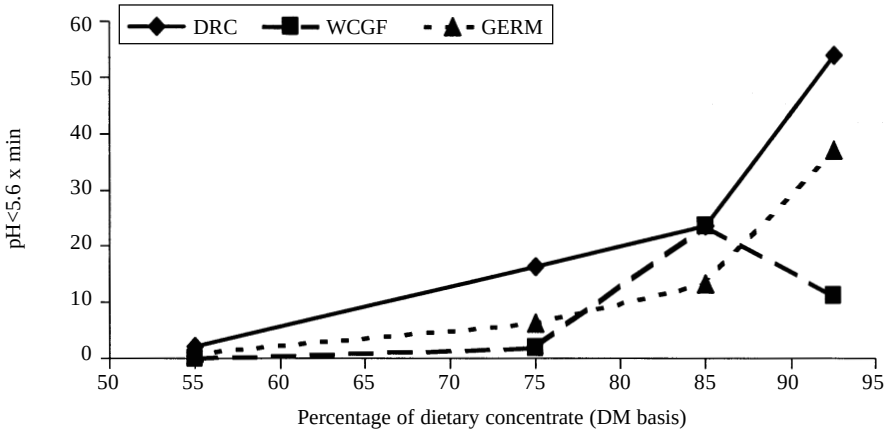


**Figure 1. Treatment x dietary concentrate level interaction (P=.07) for area <pH 5.6 (SEM=6.77). DRC=dry-rolled corn control, WCGF=50% dry corn bran and 50% steep liquor with distillers solubles (DM basis) replacing 50% of dry-rolled corn DM in the final diet, GERM=33% dry corn bran, 33% steep liquor with distillers solubles, and 33% solvent-extracted germ meal (DM basis) replacing 50% of dry rolled corn DM in the final diet.**

## Results and Discussion

### *Analysis across levels of dietary concentrate*

No treatment × dietary concentrate level interactions were observed for DM intake, intake rate, feeding time, or meal amount. Therefore, these data were pooled to assess effects of byproduct blends on intake variables. The WCGF treatment exhibited higher ($P < .10$) daily DM intake than DRC and GERM, although WCGF promoted the lowest ($P < .01$) rate of intake (Table 2). Average feeding time ($P < .10$) and maximum feeding time ($P < .05$) were greatest for the GERM treatment. Total time spent feeding was lower ($P < .05$) for the DRC treatment than byproduct diets.

Treatment × dietary concentrate level interactions were not observed for average or minimum ruminal pH, daily pH variance, or area of ruminal pH below 5.6. Therefore, these data were pooled to evaluate effects of byproduct blends. Average pH did not differ due to treatment, although daily minimum pH was maintained at a higher level by the WCGF treatment ($P < .10$; 5.65 vs 5.50 for DRC). Daily pH variance ($P < .05$) was greater for DRC and GERM treatments than the WCGF diet. A treatment × concentrate level interaction ($P = .06$) was observed for area below pH 5.6 (Figure 1). Although an interaction was observed, the area below pH 5.6 increased as the dietary concentrate level increased across treatments. However, the rate and magnitude of increase as the dietary concentrate level increased was greater for steers fed DRC compared with WCGF or GERM. The rate and magnitude of increase as the dietary concentrate level increased were similar between WCGF and GERM.

No treatment x dietary concentrate level interactions occurred for ruminal VFA or total lactate concentration; thus only treatment effects will be discussed. Total ruminal VFA concentration was greater for DRC than diets including corn byproducts ($P < .10$). Propionate concentration was greater ($P < .05$) for DRC than WCGF and GERM diets, whereas acetate was similar among

(Continued on next page)

treatments, which resulted in a lower ($P < .01$) acetate to propionate ratio for DRC. Ruminal lactate concentration was similar among treatments (data not shown).

*Postchallenge phase*

A treatment x day interaction ($P = .03$) was observed for DM intake (Figure 2). Intake of all treatments was similar for the acidosis challenge (day 1). Dry matter intake of the DRC diet declined abruptly on day 2 and gradually reached intake levels of WCGF and GERM diets by day 4. Intake rate, and average and maximum feeding time did not differ due to treatment or day (data not shown). Maximum and average meal amount differed due to day and averaged across treatments ranged from 7.98 (day 1) to 5.07 (day 2) lb and 3.02 (day 1) to 2.31 (day 3) lb, respectively, with the highest ($P < .01$) values on day 1, which suggested the procedure for acidosis challenge was successful in promoting overconsumption of high-concentrate diets. Total feeding time differed ($P = .02$) due to treatment, and with the exception of day 1, was higher for GERM (121 min) than WCGF (92 min) and DRC (98 min) treatments.

Treatment x day interactions ($P < .10$) occurred for average and minimum ruminal pH. In the WCGF treatment, minimum ruminal pH was not diminished to the extent exhibited by GERM and DRC diets due to the acidosis challenge (data not shown). Although minimum pH of the GERM treatment was similar to that of the DRC diet on day 1, GERM values for average pH exceeded the DRC treatment (data not shown). Generally, average ruminal pH data for WCGF and GERM diets resembled the consistency exhibited by DM intake data for these treatments, suggesting a decreased incidence and less extensive duration of subacute acidosis and a more rapid recovery. Ruminal pH measures for the DRC diet seemed closely linked to DM intake. Area of pH below < 5.6 tended (P = .13) to be greater for cattle fed DRC compared with those fed WCGF or GERM (Figure 3).

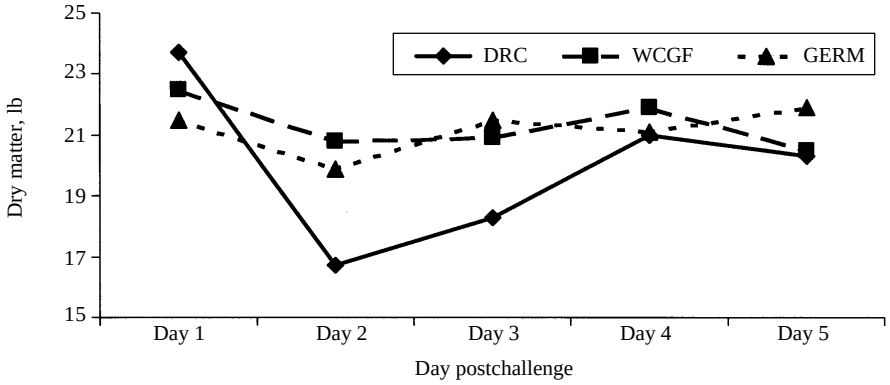


**Figure 2. Treatment x day interaction (P=.03) for average DM intake (lb/d) following the acidosis challenge (SEM=1.4). DRC=dry-rolled corn control, WCGF=50% dry corn bran and 50% steep liquor with distillers solubles (DM basis) replacing 50% of dry-rolled corn DM in the final diet, GERM=33% dry corn bran, 33% steep liquor with distillers solubles, and 33% solvent-extracted germ meal (DM basis) replacing 50% of dry-rolled corn DM in the final diet. The acidosis challenge was initiated with late feeding at 1 p.m. on day 1.**

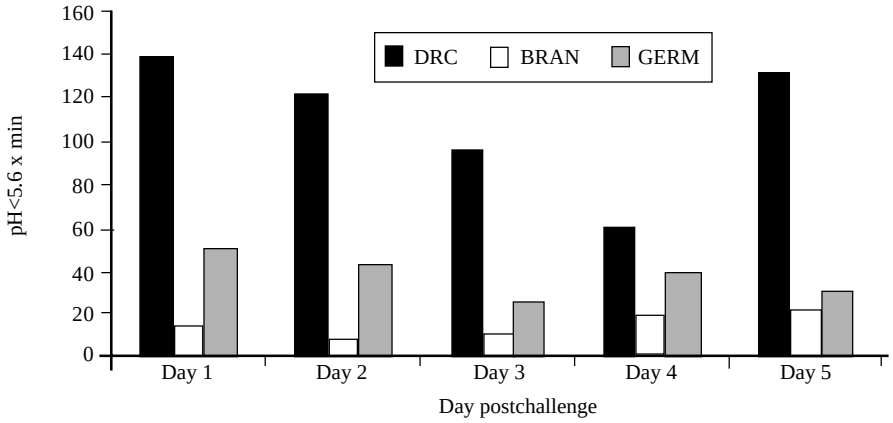


**Figure 3. Area of pH<5.6 x min following the acidosis challenge. Treatments tended to differ (P=.13) (SEM=32). DRC=dry-rolled corn control, WCGF=50% dry corn bran and 50% steep liquor with distillers solubles (DM basis) replacing 50% of dry-rolled corn DM in the final diet, GERM=33% dry corn bran, 33% steep liquor with distillers solubles, and 33% solvent-extracted germ meal (DM basis) replacing 50% of dry-rolled corn DM in the final diet. The acidosis challenge was initiated with late feeding at 1 p.m. on day 1.**

Results from the acidosis challenge were similar to those originating from the analysis involving dietary concentrate level. The WCGF and GERM diets were less apt to induce subacute acidosis than was DRC. Ruminal pH measures suggested that GERM was fermented more rapidly than WCGF, but did not reach the rate of acid production associated with DRC. Cattle consuming GERM were able to maintain a level of DM intake similar to WCGF after the acidosis challenge, although DM intake was lower during grain adaptation. Replacing a portion of the dry corn bran and steep liquor/distillers solubles with solvent-extracted germ in the production of wet corn gluten feed does not compromise the control of subacute acidosis in feedlot diets.

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