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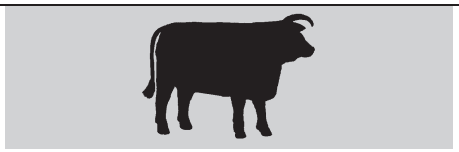

Effects of feeding calcium oxide on growth performance, carcass characteristics, and ruminal metabolism of cattle

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ABSTRACT

Three experiments tested the effects of feeding CaO as part of the TMR or as CaO-treated corn stover (CS) on growth performance, carcass characteristics, and ruminal metabolism of cattle. In Exp. 1, steers (n = 162) were fed 1 of 3 diets containing 20% CS and 40% modified wet distillers grains with solubles: untreated CS (UCS), treated CS with 5% CaO (DM basis; TCS), and dietary inclusion of 1% CaO (DM basis; DC). Feeding DC or TCS decreased (P < 0.05) DMI, final BW, HCW, and back fat compared with feeding UCS. Feeding TCS decreased (P < 0.05) ADG compared with feeding UCS. In Exp. 2, heifers (n = 138) were fed 1 of 3 diets: UCS, TCS, and 40% corn silage (DM basis; SIL). Feeding TCS decreased (P ≤ 0.05) DMI, and final BW, and back fat compared with feeding UCS and SIL. Heifers fed UCS had similar (P ≤ 0.05) ADG, DMI, and marbling score as heifers fed SIL; however, final BW and G:F were decreased (P ≤ 0.05). In Exp. 3, steers (n = 5) were fed in a 5 × 5 Latin square; diets were UCS, TCS, DC, SIL, and a control of 50% cracked corn. Feeding TCS tended to decrease (P = 0.06) ruminal pH when compared with UCS. Steers fed UCS had the least (P ≤ 0.05) DM digestibility and steers fed the control had the greatest. Treating CS with CaO effectively increased digestibility; however, it did not improve cattle performance. Feeding cattle untreated, ensiled CS resulted in ADG and G:F comparable to feeding corn silage.

Key words: calcium oxide, cattle, corn stover, distillers grains, rumen metabolism

INTRODUCTION

Increased ethanol production has increased corn demand and corn prices over the last decade. Therefore, alternatives to corn-based cattle diets are needed that will alleviate rising feed costs without decreasing cattle growth performance. Fiber-based feeds can be cheaper corn alternatives in beef cattle diets. One recently suggested fiber option in cattle diets is corn stover (**CS**); however, CS is a poor-quality fiber source (NRC, 1996) that may decrease growth performance compared with corn-based feeding strategies. Treating CS with an alkaline agent may increase energy available for beef cattle (Russell et al., 2011). Furthermore, feeding CS in combination with a high-energy protein source, such as modified wet distillers grains with solubles (**MDGS**), may be advantageous in cattle diets and further reduce corn use (Lardy, 2007). However, Felix and Loerch (2011) reported that cattle consuming diets containing dried distillers grains plus solubles (**DDGS**) have lower ruminal pH than cattle fed corn-based diets without DDGS. Decreased ruminal pH may inhibit cellulolytic bacteria necessary for fiber digestion (Mould and Orskov, 1983), a concern when feeding fiber-based diets. Alkaline agents increase the digestibility of poor-quality forages, including CS (Kamstra et al., 1958; Rounds and Klopfenstein, 1974; Shreck et al., 2012a), and reduce ruminal acidity and increase in situ fiber digestibility when feeding DDGS (Felix et al., 2012). We hypothesized that treating CS with CaO and feeding CaO with MDGS would increase fiber digestibility, similar to the digestibility of corn silage, a high-quality forage, and increase ruminal pH. Therefore, the objectives of Exp. 1 were to determine the effects of feeding CaO as part of the TMR or as CaO-treated CS

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on growth performance and carcass characteristics of finishing cattle. The objectives of Exp. 2 were to compare the effects of feeding CaO-treated CS to feeding corn silage on growth performance and carcass characteristics of finishing cattle. Finally, the objectives in Exp. 3 were to determine the effects of feeding CaO as part of the total mixed ration or as CaO-treated CS on ruminal metabolism, digestibility, and in situ DM disappearance in fistulated cattle.

MATERIALS AND METHODS

All animals used in these trials were managed according to guidelines recommended in the *Guide for the Care and Use of Agriculture Animals in Agriculture Research and Teaching* (FASS, 2010). All experimental procedures were approved by the University of Illinois Institutional Animal Care and Use Committee.

Table 1. Composition of diets fed in Exp. 1

	Dietary treatment[1]		
Item, % DM basis	UCS	TCS	DC
Ingredient			
Corn stover	20.00	—	20.00
Treated corn stover[2]	—	20.00	—
Corn silage	—	—	—
MDGS[3]	40.00	40.00	40.00
Dry-rolled corn	30.00	35.00	34.00
High-Ca supplement[4]	10.00	—	—
Low-Ca supplement[5]	—	5.00	5.00
CaO	—	—	1.00
Analyzed composition			
NDF	30.29	28.65	30.22
ADF	19.31	17.93	19.25
CP	15.69	16.19	15.78
Fat	6.39	6.35	6.47
Ca	0.99	0.83	1.10
P	0.37	0.38	0.38
S	0.29	0.29	0.27

[1]UCS = untreated corn stover, TCS = treated corn stover, DC = 1% CaO added to the diet.

[2]Corn stover brought to 50% moisture and treated with 5% CaO (71% Ca, MicroCal OF 200; Mississippi Lime Company, St. Louis, MO).

[3]MDGS = modified corn distillers grains with solubles.

[4]High-Ca supplement included: 75% corn, 23% limestone, 0.91% trace mineral salt [20% $CaCO_3$, 15.43% 4 Zinpro, 14.17% KCl, 8.75% MgO, 8% $MnSO_4$, 6.74% $FeSO_4$, 6.54% rice hulls mineral oil, 6.21% $ZnSO_4$, 5.95% S prilled, 4.41% vitamin E 50%, 1.50% Se, 1.03% $MgSO_4$, 0.88% $CuSO_4$, 0.22% vitamin A 1000, 0.13% vitamin D_3 500 MS, 0.04% $Ca(IO_3)_2$ 63.5% to yield 5% Mg, 10% S, 7.5% K, 2% Fe, 3% Zn, 3% Mn, 5,000 mg/kg of Cu, 250 mg/kg of I, 40 mg/kg of Co, 150 mg/kg of Se, 2,204,634 IU/kg of vitamin A, 7,275,293 IU/kg of vitamin D_3, 22,046 IU/kg of vitamin E], 0.15% Rumensin 90 (200 g of Rumensin/kg; Elanco Animal Health, Greenfield, IN) 0.10% Tylan 40 (80 g of Tylosin/kg; Elanco Animal Health), 0.77% fat.

[5]Low-Ca supplement included: 87% corn, 9% limestone, 1.8% trace mineral salt [20% $CaCO_3$, 15.43% 4 Zinpro, 14.17% KCl, 8.75% MgO, 8% $MnSO_4$, 6.74% $FeSO_4$, 6.54% rice hulls mineral oil, 6.21% $ZnSO_4$, 5.95% S prilled, 4.41% vitamin E 50%, 1.50% Se, 1.03% $MgSO_4$, 0.88% $CuSO_4$, 0.22% vitamin A 1000, 0.13% vitamin D_3 500 MS, 0.04% $Ca(IO_3)_2$ 63.5% to yield 5% Mg, 10% S, 7.5% K, 2% Fe, 3% Zn, 3% Mn, 5,000 mg/kg of Cu, 250 mg/kg of I, 40 mg/kg of Co, 150 mg/kg of Se, 2,404,634 IU/kg of vitamin A, 7,275,293 IU/kg of vitamin D_3, 22,046 IU/kg of vitamin E], 0.304% Rumensin 90, 0.197% Tylan 40, 1.51% fat.

Experiment 1

Animals and Diets. Angus × Simmental steers (n = 162) were placed on trial at the Beef Cattle and Sheep Field Laboratory in Urbana, Illinois. Feedlot barns were constructed of wood frames with ribbed metal roofs and siding on the north, west, and east sides. The south sides were covered with 1.27 × 1.27 cm wire mesh bird screen and had retractable curtains. Each pen had rubber-coated, slatted concrete floors and measures 4.9 × 4.9 m. Steers were blocked by initial BW, stratified by sire, and allotted to 12 heavy block pens (initial BW = 473 ± 29 kg) and 9 light block pens (initial BW = 400 ± 29 kg).

Pens within block were randomly assigned to 1 of 3 treatments (Table 1) containing 20% CS and 40% MDGS: untreated (**UCS**), treated CS only with 5% CaO (DM basis; **TCS**), and dietary inclusion of 1% CaO (DM basis; **DC**). All diets contained 20% CS (either treated or not treated with CaO) and 40% MDGS on a DM basis. The CaO diets, TCS and DC, were formulated to include 1% total dietary CaO on a DM basis. The remainder of the diets consisted of corn and a vitamin-mineral supplement, which varied in the diet. Steers were adapted to their respective diets over the course of 14 d. Diets were mixed in a mixer wagon (Knight Reel Auggie 3130; Kuhn Agricultural Machinery, Brodhead, WI) and steers were fed once daily for ad libitum intakes. Ingredient samples were collected every 2 wk, analyzed for 105° DM, and feed delivery was adjusted based on DM. Furthermore, the 2-wk samples were composited throughout the trial and analyzed as described in the sample analysis section.

In an effort to account for Ca inclusion across treatments, 2 different supplements were formulated: a high-Ca (8.8% analyzed Ca, DM basis) and a low-Ca supplement (3.5% analyzed