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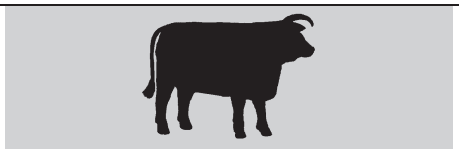

Effect of feeding corn modified to contain a unique amylase on performance and carcass characteristics of feedlot steers[1]

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ABSTRACT

A new corn hybrid has been developed through genetic modification that expresses a thermotolerant α-amylase (CA3272) that is able to process the corn starch for commercial ethanol production without the need for the addition of exogenous α-amylase. Because this amylase may improve ruminal starch digestibility and subsequently enhance performance of feedlot cattle, the objective of this research was to determine performance responses in feedlot cattle fed different concentrations of CA3272. Seventy-two Angus cross yearling steers (initial BW 349 kg ± 1.1 kg) were allotted by BW to 3 treatments to determine the effect of CA3272 concentration (0, 10, and 20% of dietary DM) on growth performance and carcass characteristics of feedlot steers. Steers were slaughtered after 131 d on feed. Final BW was similar among treatments ($P \geq 0.51$). Average daily gain, DMI, and G:F did not differ ($P \geq 0.18$) among cattle fed 0, 10, or 20% of dietary DM as CA3272, respectively. Hot carcass weight and dressing percentage did not differ among treatments ($P \geq 0.48$). Longissimus dorsi area, twelfth rib fat thickness, marbling score, and percentage of cattle grading Choice or better did not differ ($P \geq 0.13$) among cattle fed 0, 10, or 20% of the diet DM as CA3272. In conclusion, corn genetically modified to contain amylase has no effect on performance and carcass characteristics of feedlot steers when fed at a rate of 10 or 20% of dietary DM.

Key words: beef cattle, feedlot, amylase corn, ethanol

INRODUCTION

A new corn hybrid (**CA3272**) has been developed through genetic modification to express a thermotolerant α-amylase enzyme (**AMY797E**) that can be activated by high temperatures associated with the dry-grind ethanol process. Presence of the enzyme in corn replaces the need for addition of expensive exogenous microbial-produced enzymes in the ethanol fermentation process. The enzyme AMY797E is functionally similar to the thermostable, genetically engineered α-amylases (e.g., *Bacillus* spp.) currently used and has a history of safe use in food and feed processing (Pariza and Johnson, 2001; Olempska-Beer et al., 2006). Although starch degradability of CA3272 is minimal at physiologic rumen temperature, in vitro results indicate that starch disappearance increased from 1.60 to 1.99% compared with its near isogenic counterpart (Hu et al., 2010), indicating that, when fed to cattle, ruminal amylase activity and starch digestibility may be increased, thus enhancing cattle performance.

Exogenous amylase addition to high-grain feedlot diets has been demonstrated to improve performance (Tricarico et al., 2007) or have no effect (DiLorenzo et al., 2010). When exogenous amylase was supplemented to lactating dairy cows fed high-forage diets, milk production (Tricarico et al., 2005; Klingerman et al., 2009) and milk feed efficiency (Gencoglu et al., 2010) were increased and improvements in energy balance in transition dairy cows were noted (DeFrain et al.,

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2005). Because there have been no reported in vivo studies evaluating the potential of CA3272 as a feedstock for ruminants to date, the objective of the current experiment was to investigate the influence of genetically modified corn, CA3272, on performance and carcass characteristics of feedlot cattle fed distillers grains. Our hypothesis was that CA3272, when fed up to 20% of dietary DM, would improve cattle performance and carcass characteristics.

MATERIALS AND METHODS

Research protocols regarding animal care followed guidelines recommended in the *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching* (FASS, 1998) and were approved by the Iowa State University Institutional Animal Care and Use Committee. Seventy-two Angus cross yearling steers (initial BW = 349.4 ± 1.1 kg) were used at the Iowa State University Beef Center from November of 2008 to March of 2009 to determine the effect of increasing concentrations (0, 10, and 20% of dietary DM) of corn genetically modified to contain a thermotolerant α-amylase (CA3272; Syngenta Biotechnology Inc., Research Triangle Park, NC) on BW gain, feed intake, feed efficiency, and carcass characteristics of feedlot cattle. Steers were weighed on 2 consecutive days for initial BW determination, stratified by BW, and allotted to 3 treatments (4 pens per treatment; 6 steers per pen; 24 steers per treatment) in a randomized design. Pens (2.4 × 9.1 m) were located in a 3-sided, bedded concrete floor barn and provided 40 cm of bunk space per animal. Upon arrival at the Iowa State Beef Center, steers were vaccinated against bovine rhinotracheitis, bovine viral diarrhea, parainfluenza-3, bovine respiratory syncitial virus, *Haemophilus somnus*, *Pasteurella*, and *Clostridia* (Cattle Master-4, Bar Somnus 2P, and Alpha-7, respectively; Pfizer, Exton, PA), treated with IVOMEC (Merial, Duluth, GA) for internal and external parasites, and implanted with Component TE-S (provided courtesy of VetLife, Overland Park, KS).

The basal diet contained (DM basis) 20% modified dry distillers grains, 12% brome-grass hay, 2.8% supplement, and 45.2% dry rolled corn (Table 1). The remaining 20% of the diet contained ground CA3272 corn (0, 10, or 20%; respectively for the 0, 10, and 20% CA3272 diets) or ground corn that was not genetically modified (20, 10, or 0% for the 0, 10, and 20% CA3272 diets). The CA3272 corn was received in the ground form; thus, ground corn was added to the 0 and 10% CA3272 diets to account for any potential corn processing effect. All diets were formulated to meet or exceed NRC (1996) requirements for protein, energy, vitamins, and minerals. Because of unexpectedly low protein values for corn and modified distillers grains, actual CP content was 11.6%. Total mixed diets were offered once daily at 0800 h, cattle were allowed ad libitum access to feed and water, and feed delivery and refusals were recorded daily for each pen. Feed samples were collected every other week, oven-dried at 55°C for 3 d, ground using a standard Wiley laboratory mill (1-mm screen; Arthur H. Thomas, Philadelphia, PA), and composited at the end of the experiment for analysis of DM (AOAC, 1990), CP (micro-Kjeldahl N × 6.25), NDF and ADF (Ankom Technology Methods 5 and 6, respectively, Ankom Technology Corporation, Fairport, NY), ether extract (AOAC, 1990), and minerals (Ca, P, Mg, K, S; AOAC, 1990).

Steers were weighed monthly and on 2 consecutive days at the onset of the experiment and at slaughter to determine initial and final BW, respectively. Steers were weighed before feed delivery. Average daily gain was determined by the difference between final and initial BW divided by the number of days on feed. Feed efficiency was determined by dividing ADG by DMI. Cattle were slaughtered at a commercial packing facility (Tyson Foods, Denison, IA) after 131 d when BW (603 kg) and visual appraisal of carcass fatness were determined to be adequate. Hot carcass weight, twelfth rib fat thickness, percentage of KPH, LM area, and USDA QG and YG were determined for all cattle by qualified Iowa State University personnel 48 h after slaughter. One steer was removed from the experiment on d 91 for reasons unrelated to treatment.

Data were analyzed by using the MIXED procedures of SAS (Version 8.0, SAS Institute Inc., Cary, NC). Pen was the experimental unit for all the analyses and was included in the model as a random effect. The model included the random effect of pen and the fixed effects of CA3272 concentration, as well as the CA3272 concentration by day interaction. Four covariance structures were compared for each variable (compound symmetric, autoregressive order one, heterogeneous autoregressive order one, and unstructured), and the covariance structure that yielded the smallest Bayesian information criterion was used for the results presented. Quality grade data were analyzed using the GLIMMIX procedures of SAS. Linear and quadratic coefficients were generated by using PROC IML and were used to determine the dose-dependent effect of CA3272 inclusion. The least squares means (**LSMEANS**) statement was used to calculate the adjusted means for CA3272 concentrations. Differences were considered statistically significant when $P \leq 0.05$, and tendencies were discussed when $0.05 < P \leq 0.10$.

RESULTS AND DISCUSSION

Performance data for the steers are presented in Table 2. Final BW was similar among treatments and averaged 603 kg ($P \geq 0.51$). Average daily gain ($P \geq 0.42$), daily DMI ($P \geq 0.18$), and feed efficiency ($P > 0.20$) did not change in either period or overall because of CA3272 inclusion. There are no previous reports of the effect of corn modified to contain α-amylase on feedlot cattle performance and carcass characteristics. Numerous studies, however, have investigated the effect of exogenous α-amylase. The effects of exogenous α-amylase supplementation have