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Marie E. Harris
University of Nebraska–Lincoln

Galen E. Erickson
University of Nebraska–Lincoln, gerickson4@unl.edu

Karla H. Jenkins Jenkins
University of Nebraska-Lincoln, kjenkins2@unl.edu

Matt K. Luebbe
UNL Panhandle Research and Extension Center, mluebbe2@unl.edu

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Karla H. Jenkins
Matt K. Luebbe[1]

Summary

Performance and carcass characteristics were evaluated using five concentrations of corn condensed distillers solubles (CCDS) replacing steam-flaked corn (SFC) in feedlot finishing diets using crossbred steers. As CCDS replaced SFC at concentrations of 0, 9, 18, 27, or 36% of the diet DM, DMI decreased quadratically. Average daily gain increased quadratically with greatest gains observed at 27% CCDS inclusion. A quadratic improvement was observed in F:G with optimum concentrations similar to what was observed for ADG at 27% CCDS inclusion. These results suggest corn condensed distillers solubles can effectively be used to replace SFC in feedlot finishing diets while improving ADG and F:G.

Introduction

Byproducts from the dry-milling ethanol process can be used in cattle diets to replace corn. Wet distillers grains with solubles (WDGS) interacts with corn processing methods (*2007 Nebraska Beef Cattle Report*, pp. 33-35). When replacing corn with WDGS, there is a greater improvement in F:G when DRC diets are fed compared to SFC diets. However, with distillers solubles (CCDS), the same interaction has not been observed. In fact, including 30% CCDS in SFC-based diets improved F:G to a greater extent compared with DRC-based diets (*2013 Nebraska Beef Cattle Report*, pp. 51-52), but 30% was the maximum inclusion evaluated. Previous work has shown that up to 36% of the diet (DM basis) of CCDS can be fed with a 50:50 blend of DRC and HMC (DRC:HMC) while improving gain and feed efficiency (*2012 Nebraska Beef Cattle Report*, pp. 64-65). Therefore, the objective of this study was to determine if greater concentrations of CCDS could be fed in SFC-based diets without reducing performance.

Materials and Methods

Four hundred forty crossbred steers (initial BW = 878 ± 49 lb) were utilized in a feedlot finishing trial at the University of Nebraska–Lincoln Panhandle Research Feedlot near Scottsbluff, Neb. Cattle were limit-fed a diet at 2% BW consisting of 40% wet distillers grains with solubles, 30% alfalfa hay, 20% corn silage, and 10% wheat straw (DM basis) for five days prior to the start of the experiment. Two-day initial weights were recorded on day 0 and 1 and were averaged and used as the initial BW. The steers were blocked by BW into light, medium, and heavy BW blocks, stratified by BW and assigned randomly to one of 40 pens with pen assigned randomly to one of five dietary treatments. There were 11 head per pen and eight replications per treatment. Dietary treatments included 0, 9, 18, 27, or 36% CCDS replacing SFC and urea (Table 1). The corn was flaked at a target density of 28 lb/bushel at a commercial feedlot (Panhandle Feeders, Morrill, Neb.).

The composition of the CCDS used in this trial (Colorado Agri Products, Bridgeport, Neb.) contained 24.3% DM, 16.0% CP, 20.1% Fat, and 0.41% S (DM basis). Soybean meal (SBM) and urea were added to the diets to meet or exceed MP requirements of the animal. All diets contained 16% corn silage, 3.5% SBM, and 4.0% pelleted supplement (DM basis).

Steers were implanted with Component T-200 (Elanco Animal Health) on day 1. Animals in the heavy BW block were harvested on day 89 and the medium/light BW blocks were harvested on day 104 (Cargill Meat Solutions, Fort Morgan, Colo.). Hot carcass weight and liver scores were recorded on the slaughter date. Fat thickness, LM area, and marbling score were recorded after a 48-hour chill. Final BW, ADG, and F:G were calculated using HCW adjusted to a common 63% dressing percentage.

Data were analyzed using the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.) as a randomized block design. Pen was the experimental unit and block was treated as a random effect.

Results

Dry matter intake decreased quadratically ($P = 0.02$) as the concentration of CCDS increased in the diet (Table 2). Average daily gain increased quadratically ($P < 0.01$) as CCDS increased with greatest gains observed at 27% and slightly decreased at 36%. There was a quadratic improvement ($P < 0.01$) in F:G as CCDS concentration increased in the diet. Less feed was consumed per pound of gain from 0% CCDS up to the 27% CCDS diet, but F:G increased at 36% CCDS. Even though a small increase in F:G was observed for cattle fed 36% CCDS compared with the optimum at 27%, the F:G was improved compared with the control diet. Hot carcass weight increased quadratically ($P < 0.01$) as CCDS increased, also peaking at 27% CCDS. Marbling score and calculated YG increased quadratically ($P = 0.08$ and 0.06, respectively). Fat thickness and LM area also tended to increase quadratically ($P = 0.13$ and 0.07, respectively) as CCDS increased in the diet. There was a trend ($P = 0.10$) for an increasing linear response for dressing percentage as CCDS increased in the diet. These results were similar to

Table 1. Dietary treatments and nutrient analysis for steers fed CCDS[1] (DM basis).

	CCDS, % Diet DM				
	0	9	18	27	36
Ingredient, %					
SFC[2]	75.6	66.8	57.9	49.2	40.4
Silage	16.0	16.0	16.0	16.0	16.0
CCDS	0.0	9.0	18.0	27.0	36.0
SBM	3.5	3.5	3.5	3.5	3.5
Urea	0.9	0.7	0.6	0.3	0.1
Supplement[3]	4.0	4.0	4.0	4.0	4.0
Analyzed Composition, %					
Crude Fat	2.8	4.4	5.9	7.5	9.0
Crude Protein	13.5	13.7	14.1	14.0	14.1
Calcium	0.55	0.56	0.57	0.58	0.59
Phosphorus	0.25	0.36	0.46	0.57	0.68
Sulfur	0.11	0.12	0.14	0.15	0.17

[1]CCDS = corn condensed distillers solubles, SFC = steam-flaked corn, SBM = soybean meal.
[2]Flake density was 28 lb/bu.
[3]The same pelleted supplement was used for all diets, providing 0.687% urea. 360 mg Rumensin® and 90 mg Tylan® per head/day was added using a micro machine.

Table 2. Effect of corn condensed distillers solubles in steam-flaked corn-based diets on performance and carcass characteristics.

	CCDS[1], % Diet DM						*P*-value	
Item	0	9	18	27	36	SEM[2]	Linear[3]	Quad.[4]
Performance								
Initial BW, lb	879	876	877	878	879	1.382	0.58	0.11
Final BW, lb[5]	1293	1323	1320	1332	1293	8.997	0.63	<0.01
DMI, lb/day	26.0	26.0	25.3	25.1	23.8	0.377	<0.01	0.02
ADG, lb[5]	4.18	4.50	4.47	4.57	4.17	0.095	0.83	<0.01
F:G[5,6]	6.21	5.79	5.68	5.49	5.71	0.004	<0.01	<0.01
Carcass Characteristics								
HCW, lb	815	834	832	839	815	5.650	0.65	<0.01
Marbling Score[7]	525	532	534	533	512	12.231	0.37	0.08
Calculated YG[8]	3.37	3.46	3.52	3.52	3.45	0.074	0.21	0.06
12th rib fat, in	0.56	0.58	0.59	0.60	0.58	0.019	0.11	0.13
LM area, in. sq.	12.5	12.7	12.6	12.7	12.3	0.165	0.24	0.07
Dressing, %	61.6	61.9	62.0	62.2	62.0	0.291	0.10	0.22
Liver abscess[9,10] %	10.98	8.43	14.46	9.76	9.52	—	0.83	—
A, %	4.88	4.82	9.64	6.10	5.95	—	0.71	—
A+, %	6.10	3.61	4.82	3.66	3.57	—	0.93	—

[1]CCDS = concentration of condensed distillers solubles in diet.
[2]SEM = standard error of the mean for the interaction.
[3]Linear effect for the concentration of CCDS included ($P < 0.05$).
[4]Quad. = quadratic effect for the concentration of CCDS included ($P < 0.05$).
[5]Final BW calculated from hot carcass weight adjusted to a common dressing percentage of 63%.
[6]Analyzed as G:F, reciprocal of F:G.
[7]Marbling score: 400 = Slight 0, 500 = Small 0.
[8]Calculated YG = 2.5 + 2.5 (fat thickness, in) – 0.32 (LM area in. sq.) + 0.2 (2.5 KPH fat, %) + 0.0038 (hot carcass weight, lb).
[9]Liver score: A = 3 or 4 abscesses; A+ = 4 or more abscesses.
[10]*P*-value listed is Protected F-test value.

previous data when CCDS was fed in DRC:HMC based diets (*2012 Nebraska Beef Cattle Report*, pp. 64-65).

These data with CCDS in SFC-based diets disagree with previous data evaluating SFC and distillers grains. Previous data with distillers grains suggest that increasing concentrations of WDGS in SFC-based diets slightly decreases ADG and has no effect on F:G. However, in HMC or DRC-based diets, ADG and F:G are improved with WDGS (*2007 Nebraska Beef Cattle Report*, pp. 33-35). In our hypothesis, we expected a similar result would occur with CCDS and SFC, but ADG and F:G were actually improved with increasing concentrations of CCDS in SFC-based diets in this study as well as a previous study (*2013 Nebraska Beef Cattle Report*, pp. 51-52).

Feeding distillers byproducts with greater concentrations of sulfur (S) increases the incidence of S toxicity (Polioencephalomalacia). During the experiment, a load of CCDS was delivered after the plant flushed their system with sulfuric acid. Six steers were treated for S toxicity. Three steers were on the 18% CCDS diet and one each from the 9%, 27%, and 36% CCDS diets. Two steers became chronic and were subsequently removed from the trial (one each from 18% and 27% CCDS diets). An analysis of the S content of the CCDS was 2.59% S on a DM basis. A bunk sample from the 36% CCDS treatment was 0.92% S (DM basis). These concentrations of S exceed toxic amounts of 0.46% S of the total diet DM (*2009 Nebraska Beef Cattle Report*, pp. 79-80). Logically, it was thought more toxicity would have been observed from steers fed the 36% CCDS concentration diet, but it is believed those concentrations were greater than the threshold and steers decreased DMI similar to previous studies (*2011 Nebraska Beef Cattle Report*, pp. 62-64). However, the steers on the 18% CCDS diet may have continued to consume feed and subsequently had a greater incidence of adverse reactions.

This study suggests feeding condensed distillers solubles can effectively be used to replace SFC in feedlot finishing diets up to 36% of the total diet DM. The lowest observed F:G was at 27% CCDS, at which the steers were 13% more efficient than those fed 0% CCDS. This was not the same interaction observed with SFC and WDGS. The optimum CCDS concentration for ADG was calculated at 17.5% and 25% for optimum F:G. The decision to feed CCDS to replace corn would depend on price relative to corn on a DM basis. Markets will dictate whether elevated concentrations of CCDS will be economical in finishing diets with SFC.

[1]Marie E. Harris, graduate student; Galen E. Erickson, professor, University of Nebraska–Lincoln (UNL) Department of Animal Science, Lincoln, Neb.; Karla H. Jenkins, assistant professor; Matt K. Luebbe, assistant professor, UNL Panhandle Research and Extension Center, Scottsbluff, Neb.