Effect of Adding Urea to Finishing Diets Containing Two Different Inclusions of Distillers Grains on Steer Performance and Carcass Characteristics

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Summary with Implications

The effects of adding urea to a dry rolled corn based finishing diet containing low inclusions of distillers grains was evaluated. Treatments were designed as a 2 × 4 factorial arrangement with factors consisting of wet distillers inclusion (either 12 or 20% of diet DM) and urea inclusion (0, 0.4, 0.8, 1.2% of diet DM). There were no significant interactions observed between distillers inclusion and urea inclusion in the diet. Increasing inclusion of distillers grains improved carcass adjusted average daily gain and feed conversion and reduced dry matter intake. Increasing distillers inclusion also increased 12th rib fat and had a tendency to increase hot carcass weight. There were no significant linear or quadratic responses for increasing urea inclusion in the diet. These data suggest that when feeding at least 12% distillers in the diet, supplemental urea has minimal impact on animal performance.

Introduction

Distillers grains is a good source of protein in finishing diets. However, the majority of protein in distillers grains is in the form of rumen undegradable protein (RUP) which may create a deficiency in rumen degradable protein (RDP) in diets where low inclusions of distillers are used. However, when RUP is fed at levels that exceed the animal's requirement, the amine group from the excess protein can be removed and the nitrogen can be recycled back to the rumen and alleviate a RDP deficiency. Previous research would suggest that when feeding distillers grains in dry rolled corn (DRC) based diets at greater than 25% of diet DM, no additional urea supplementation is needed to maintain animal performance. Additionally, research evaluating the impact of adding urea to finishing diets containing 10, 15, or 20% distillers grains observed minimal impact in adding urea to dry rolled corn based (*2019 Nebraska Beef Cattle Report*, pp. 97–99). Likewise, other research evaluated feeding 10 or 20% dry distillers grains with or without urea and suggested that there was no average daily gain (ADG) response with added urea. However, there was a numerical improvement in feed conversion for cattle fed 10% distillers diet with urea (*2005 Nebraska Beef Cattle Report*, pp. 42–44).

With limited research on the topic and with more producers using 10 to 20% distillers in diets (DM basis), the objective of this research was to determine the effects of supplementing urea in dry rolled corn based finishing diets containing 12 or 20% distillers grains.

Table 1. Diet ingredient composition as % of diet DM by treatment

	12% Distillers				20% Distillers			
Ingredient	0	0.4	0.8	1.2	0	0.4	0.8	1.2
Dry-rolled corn	67	67	67	67	59	59	59	59
WDGS	12	12	12	12	20	20	20	20
Corn Silage	15	15	15	15	15	15	15	15
Supplement[1]	6	5.6	5.2	4.8	0	.4	.8	1.2
Urea[20]	0	0.4	0.8	1.2	6	5.6	5.2	4.8
Crude Protein, %	10.8	11.9	13.1	14.2	12.6	13.7	14.9	16.0
Initial MP Balance[3], g/d	-30	69	96	108	88	149	191	181
Initial RDP Balance g/d	-195	-77	46	171	-133	-13	106	225
Midpoint MP Balance[3], g/d	28	133	163	176	159	229	262	253
Midpoint RDP Balance, g/d	-210	-83	50	183	-142	-14	114	241

[1]Micro Machine used to add 360 mg/steer of Rumensin and 90 mg/steer of Tylan to the diet daily.

[2]Urea was included in the supplement, therefore, the total supplement included in the diet was the sum of the urea and supplement rows for the respective treatment. A total of 6% of diet DM of the supplement was included in all diets.

[3]Metabolizable Protein balance calculated using 1996 NRC Model to predict MP supply corrected for RDP balance deficiency if one existed (MP balance-(RDP balance*.64)).Initial MP balance is calculated for the end of the step up period and midpoint MP was calculated for the middle of the finishing period.

Procedure

Three hundred and eighty four crossbreed steers were utilized in a study at the Panhandle Research and Extension Center near Scottsbluff NE. Treatments were set up in a 2 × 4 factorial arrangement with factors consisting of two distillers inclusion (12 or 20% of the diet DM) and four urea inclusions (0, 0.4, 0.8, and 1.0% of diet DM). Diets were DRC based using corn silage as the roughage source (Table 1). A liquid supplement containing either 0 or 1.2% urea was utilized and the 0.4% and 0.8% urea treatments contained a blend of the 0 and 1.2% urea supplements. Cattle were fed once daily in the morning and fed ad libitum. Rumensin was supplied at 360 mg/steer and Tylan was supplied at 90 mg/steer daily using a micro machine (Animal Health International).

Cattle were limit fed a common diet for 5 days prior to the first initial weight at an estimated 2% of BW. Cattle were weighed on d 0, blocked by BW and assigned randomly to pen and pen assigned randomly to treatment based off of this weight. Cattle were then weighed again on d 1 and sorted into their respective pen. Three blocks were used with one replication in the light block, three replications in the middle block, and two replications in the heavy block. This

Table 2. Main effects of dietary urea inclusion on animal performance and carcass measurements

	Urea						*P*-Value		
Item	0%	0.4%	0.8%	1.2%	SEM	*P*-Value	Lin	Quad	Cubic
Live Performance									
Initial BW, lb	633	633	634	635	1.1	0.40	0.11	0.66	0.68
Final BW, lb	1358[ab]	1386[a]	1336[b]	1354[ab]	13.5	0.07	0.29	0.70	0.02
ADG, lb	4.21[ab]	4.37[a]	4.07[b]	4.17[ab]	0.077	0.07	0.24	0.71	0.02
DMI, lb/d	25.4	25.9	25.1	25.5	0.28	0.26	0.74	0.84	0.05
F:G	6.02	5.92	6.13	6.10	-	0.36	0.28	0.73	0.16
Carcass Adjusted Performance									
Initial BW, lb	633	633	634	635	1.1	0.40	0.11	0.66	0.68
Final BW, lb	1374[ab]	1395[a]	1353[b]	1377[ab]	9.7	0.03	0.44	0.87	0.004
ADG, lb	4.30[ab]	4.41[a]	4.17[b]	4.30[ab]	0.06	0.03	0.34	0.83	0.005
DMI, lb/d	25.4	25.9	25.1	25.5	0.28	0.26	0.74	0.84	0.05
F:G	5.88	5.85	6.02	5.92	-	0.23	0.36	0.63	0.08
Carcass Characteristics									
HCW, lb	866[ab]	878[a]	852[b]	867[ab]	6.1	0.03	0.44	0.85	0.005
Dressing %	63.7	63.5	63.8	64.1	0.5	0.87	0.54	0.61	0.77
LM Area, in^2	13.6	14.0	13.8	13.8	0.1	0.26	0.57	0.24	0.13
12th Rib Fat, in	0.57	0.57	0.53	0.56	0.02	0.55	0.62	0.41	0.28
Marbling[1]	482	488	481	488	9.4	0.93	0.80	0.95	0.53
USDA YG	3.3	3.3	3.2	3.3	0.08	0.46	0.40	0.24	0.48

Values within row with similar superscripts are not different (P > 0.05)

[1]300 = slight, 400 = Small, 500 = Modest.

totaled 48 pens with 8 steers/pen, and 6 replications per treatment.

Cattle were implanted with a TE-IS (Elanco Animal Health) on day 1 and reimplanted with TE-200 (Elanco Animal Health) on d 98 of the finishing period. The heavy block was on feed for 162 d and the light and mid blocks were on feed for 180 d. Cattle were slaughtered at a commercial abattoir (Cargill Meat Solutions, Fort Morgan, CO). Kill order and HCW were collected on day of slaughter and carcass data were collected after a 48 hr chill.

Performance and carcass data were analyzed using the MIXED procedure of SAS with block and treatment as fixed effects. Interactions between distillers and urea inclusion were tested and if not significant the main effects of treatment were investigated. Linear and quadratic effect of urea inclusion was analyzed using contrast statements.

Results

There were no significant interactions ($P \geq 0.14$) between distillers and urea inclusion for final body weight (BW), ADG, dry matter intake (DMI), feed conversion (F:G), or carcass characteristics, therefore, only the main effects of distillers level and urea level are presented (Table 2 and Table 3). Increasing inclusion of distillers grains from 12 to 20% improved F:G ($P < 0.01$) on both a live and carcass adjusted basis. Increasing inclusion of distillers grains increased carcass adjusted ADG ($P = 0.04$). Live ADG was numerically increased ($P = 0.20$) but was not significantly different due to greater variation. Increasing inclusion of distillers decreased DMI ($P = 0.04$) and had a tendency ($P = 0.07$) to increase carcass adjusted final BW. There was a tendency ($P = 0.07$) for increasing distillers grains to increase HCW. Increasing distillers grains increased both USDA yield grade and 12th rib fat ($P = 0.04$) but had no effect ($P > 0.63$) on other carcass measures.

Cubic responses were observed for increasing urea inclusions in the diet for many performance measures; however, a cubic effect is of minimal biological relevance as it signifies a measure that is going up and down as you add urea in the diet. In the current trial, these cubic effects are likely associated with random variation that occurred mostly at the 0.8% inclusion of urea where a decrease was observed in ADG and increase in F:G before going the opposite direction at the 1.2% inclusion rate. There were no significant ($P \geq 0.11$) linear or quadratic responses observed for any performance or carcass measure for increasing urea inclusion. There was a significant main effect ($P < 0.03$) for carcass adjusted final BW, ADG and HCW across urea inclusions suggesting variation due to imposed treatments. There was no difference in these measures for the 0, 0.4, and 1.2% urea in the diet; however, the 0.8% urea inclusion decreased these measures when compared to the 0.4% inclusion level but was not different than the 0 or 1.2% urea levels. Conservatively, adding 0.4% urea may be an opportunity with low distillers grains diets, but the response observed above 0.4% urea inclusion needs to be repeatable.

Conclusion

Increasing distillers grains in the diet improved ADG, F:G, and tended to increase HCW. Adding urea to the diet had minimal impact on animal performance

Table 3. Main effects of dietary distillers inclusion on animal performance and carcass measurements

	Distillers Inclusion			
Measure	12	20	SEM	*P*-Value
Live Performance				
Initial BW, lb	634	633	0.8	0.36
Final BW, lb	1350	1367	9.8	0.22
ADG, lb	4.16	4.26	0.056	0.20
DMI, lb/d	25.7	25.2	0.20	0.04
F:G	6.21	5.92	-	0.01
Carcass Adjusted Performance				
Initial BW, lb	634	633	0.8	0.36
Final BW, lb	1366	1383	7.0	0.07
ADG, lb	4.24	4.35	0.04	0.04
DMI, lb/d	25.7	25.2	0.20	0.04
F:G	6.06	5.78	-	0.001
Carcass Characteristics				
HCW, lb	860	872	4.5	0.07
Dressing %	63.7	63.9	0.4	0.79
LM Area, in^2	13.8	13.8	0.1	0.63
12^{th} Rib Fat, in	0.54	0.58	0.01	0.04
Marbling[1]	486	484	6.8	0.80
USDA Yield Grade	3.18	3.35	0.06	0.04

[1]300 = slight, 400 = Small, 500 = Modest.

and while there was a reduction in performance at 0.8% inclusion level, this response is not easy to explain. With improved performance, it may be economical to include at least 20% distillers grains in a dry rolled corn based finishing diet as distillers grains not only provides protein to the diet but also added energy. When feeding at least 12% distillers grains in a DRC based finishing diet adding supplemental urea is of limited benefit.

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