



Evaluation of KWS Hybrid Rye on Growth Performance, Carcass Traits, and Efficiency of Net Energy Utilization in Finishing Steers

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Introduction

- Cereal rye offers unique agronomic benefits when included in a crop rotation with row crops.
- Novel rye hybrids have demonstrated increased yield and reduced ergot alkaloid concentration compared to cereal rye population genetics.
- Standard recommendation has been to limit rye inclusions in finishing diets due to concerns with palatability and ergot alkaloid concentration (Matsushima, 1979).
- To the best of our knowledge there has been no research conducted to evaluate hybrid rye as a substitute for dry rolled corn (DRC) in modern cattle finishing diets incorporating corn processing co-products.

Objective

Evaluate the effects of hybrid rye on growth performance and carcass characteristics in finishing steer diets and determine the comparative net energy value when substituted for DRC.

Materials and Methods

- All procedures approved by SDSU Institutional Animal Care and Use Committee (IACUC, approval # 19-047E).
- Predominately Angus steers (n = 240, initial shrunk BW 891 ± 40.7 lbs.) were used in a completely randomized design.
- Cattle were fed in outside pens at the Southeast Research Farm (SERF) near Beresford, SD.
- Single hybrid of rye (KWS Bono, KWS Cereals USA, LLC, Champaign, IL)
 - Coarsely cracked (processing index, PI = 78.8 ± 2.29)
 - Ergot alkaloid concentration 392 ppb (NDSU Diagnostic Laboratory, Fargo, ND).
- Four treatments with varying proportions of DRC to hybrid rye on a DM basis (DRC:Rye):
 - 60:0
 - 40:20
 - 20:40
 - 0:60
- Steers were vaccinated against respiratory pathogens (IBR, BRSV, PI3, BVD Types 1 & 2) and clostridial species and administered a steroidal implant (200 mg trenbolone acetate and 28 mg estradiol benzoate) at trial initiation.
- Steers were adapted to high-concentrate diets using three step-up diets through d 18.
- Actual diet formulations were based upon weekly DM analyses of diet ingredient samples.
- Steers were shipped when average 12th rib fat thickness (RF) was estimated to be 0.5 in.
- HCW and liver abscess scores were recorded on harvest floor. Video camera image data was obtained from the plant for ribeye area (REA), RF, KPH percentage, USDA marbling scores, Quality Grade (QG) and Yield Grades (YG).
- Due to weather related mud and tag at time of harvest, all performance values shown are carcass-adjusted and calculated from (HCW/0.625).
- Empty body fat (EBF) percentage and final BW at 28% EBF (AFBW) were calculated from observed carcass traits (Guiroy et al., 2002) as well as proportion of closely trimmed retail cuts (Retail Yield, RY; Murphey et al., 1960).
- Observed dietary NE was calculated from d 19 to d 117 using procedures outlined by Zinn and Shen (1998) and Zinn (1987).
- Comparative NE_M and NE_G for rye were estimated using the replacement technique:
 - Rye NE_M and NE_G, Mcal/cwt = [(0:60 NE_{M or G} - 60:0 NE_{M or G})/Rye_v + DRC NE_{M or G}] where Rye_v = inclusion of rye replacing DRC (0.60). NE_M and NE_G for DRC assumed to be 100 and 68 Mcal/cwt, respectively.
- Statistical Analysis:
 - Growth performance, carcass traits, and efficiency of dietary energy were analyzed as a completely randomized design using the GLIMMIX procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC) with pen as the experimental unit with the fixed effects of treatment.
 - Treatment effects were evaluated by the use of orthogonal polynomials (Steel and Torrie, 1960).
 - Distributions of QG, YG, and liver abscess data were analyzed as binomial proportions using the GLIMMIX procedure.
 - DMI was analyzed using GLIMMIX using repeated measures.
 - An α of 0.05 determined significance and an α of 0.06 to 0.10 was considered a tendency.

Experimental Finishing Diets (d 19 to 117), DM Basis

Table 1. Composition of experimental finishing diets fed to steers from d 19 to 117 (DM basis).

Item	DRC:Rye grain inclusion (DM basis)			
	60:0	40:20	20:40	0:60
Actual ingredient inclusion (% DM)				
DRC	60.34	40.33	20.22	0.00
Hybrid Rye	0.00	19.91	39.93	60.04
MDGS	18.90	18.95	19.00	19.04
Corn silage	16.84	16.89	16.93	16.97
Liquid Supplement ¹	3.91	3.92	3.93	3.94
Tabular nutrient composition (DM basis)				
NE _M , Mcal/cwt	94.21	91.40	88.59	85.75
NE _G , Mcal/cwt	63.82	61.42	59.01	56.59
CP, %	12.70	13.34	13.98	14.63
NDF, %	17.00	19.01	21.03	23.06
ADF, %	7.31	8.52	9.73	10.95
ASH, %	4.92	5.05	5.17	5.30
EE, %	4.26	3.92	3.58	3.24

¹ Provided 30 g/ton of monensin as well as vitamins and minerals to exceed requirements (NASEM, 2016).

Results: Growth Performance and Carcass Traits

Table 2. Influence of replacing dry-rolled corn (DRC) with Rye grain on growth performance and dietary energy of feedlot steers.

	DRC:Rye grain inclusion, % DM basis				SEM	P-value		
	60:0	40:20	20:40	0:60		0 vs. Rye	Linear	Quadratic
Pens, n	6	6	6	6	-	-	-	-
Steers, n	59	59	60	60	-	-	-	-
Cumulative, carcass adjusted performance								
Initial BW, lbs ¹	885	890	892	896	-	-	-	-
Final BW, lbs ²	1432	1429	1393	1367	10.8	0.01	0.01	0.32
ADG, lbs	4.68	4.60	4.28	4.03	0.094	0.01	0.01	0.36
DMI, lbs	28.01	27.71	27.29	26.74	0.148	0.01	0.01	0.42
F:G	6.01	6.03	6.38	6.63	0.110	0.01	0.01	0.32
G:F	0.167	0.166	0.157	0.150	0.0030	0.02	0.01	0.38
Energetics assessment period (d 19 to 117)								
d 19 BW, lbs ¹	941	952	963	972	5.0	0.01	0.01	0.84
Final BW, lbs ²	1432	1429	1393	1367	10.8	0.01	0.01	0.32
ADG, lbs	5.01	4.86	4.38	4.03	0.117	0.01	0.01	0.40
DMI, lbs	29.40	29.02	28.51	27.86	0.176	0.01	0.01	0.43
F:G	5.89	5.99	6.51	6.92	0.128	0.01	0.01	0.25
G:F	0.170	0.167	0.154	0.145	0.0034	0.01	0.01	0.39
Observed dietary NE, Mcal/cwt								
Maintenance	93.98	93.20	89.71	86.54	1.225	0.01	0.01	0.34
Gain	63.82	63.14	60.08	57.30	1.075	0.01	0.01	0.34
Observed/Expected dietary NE								
Maintenance	0.99	1.02	1.01	1.01	0.014	0.31	0.65	0.36
Gain	1.00	1.03	1.02	1.01	0.018	0.35	0.73	0.35
Estimated NE value of Rye, Mcal/cwt								
Maintenance	-	-	-	87.60	-	-	-	-
Gain	-	-	-	57.13	-	-	-	-

¹ Body weight (BW) was shrunk 4% to account for digestive tract fill.

² Calculated as: HCW/0.625.

Treatment (DRC:Rye) effects on DMI (lb/hd/d)

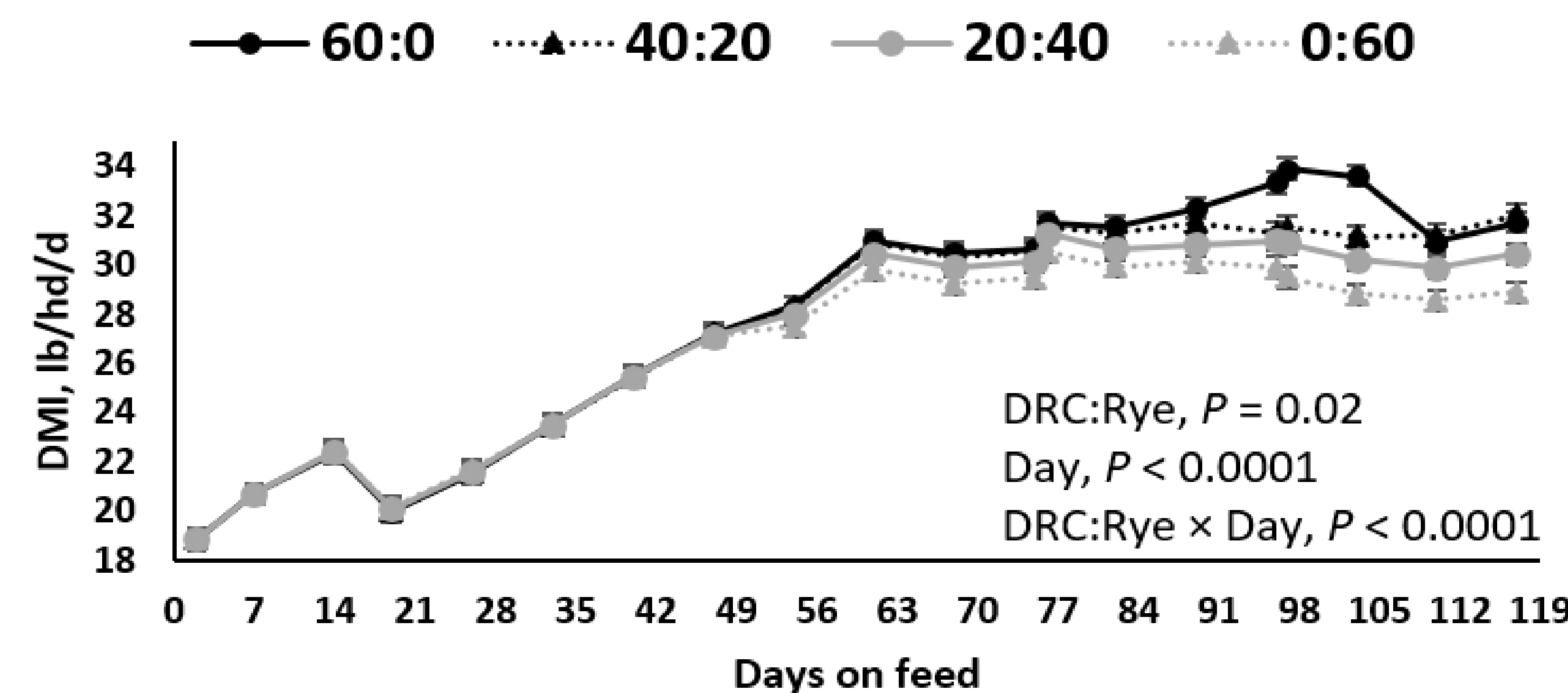


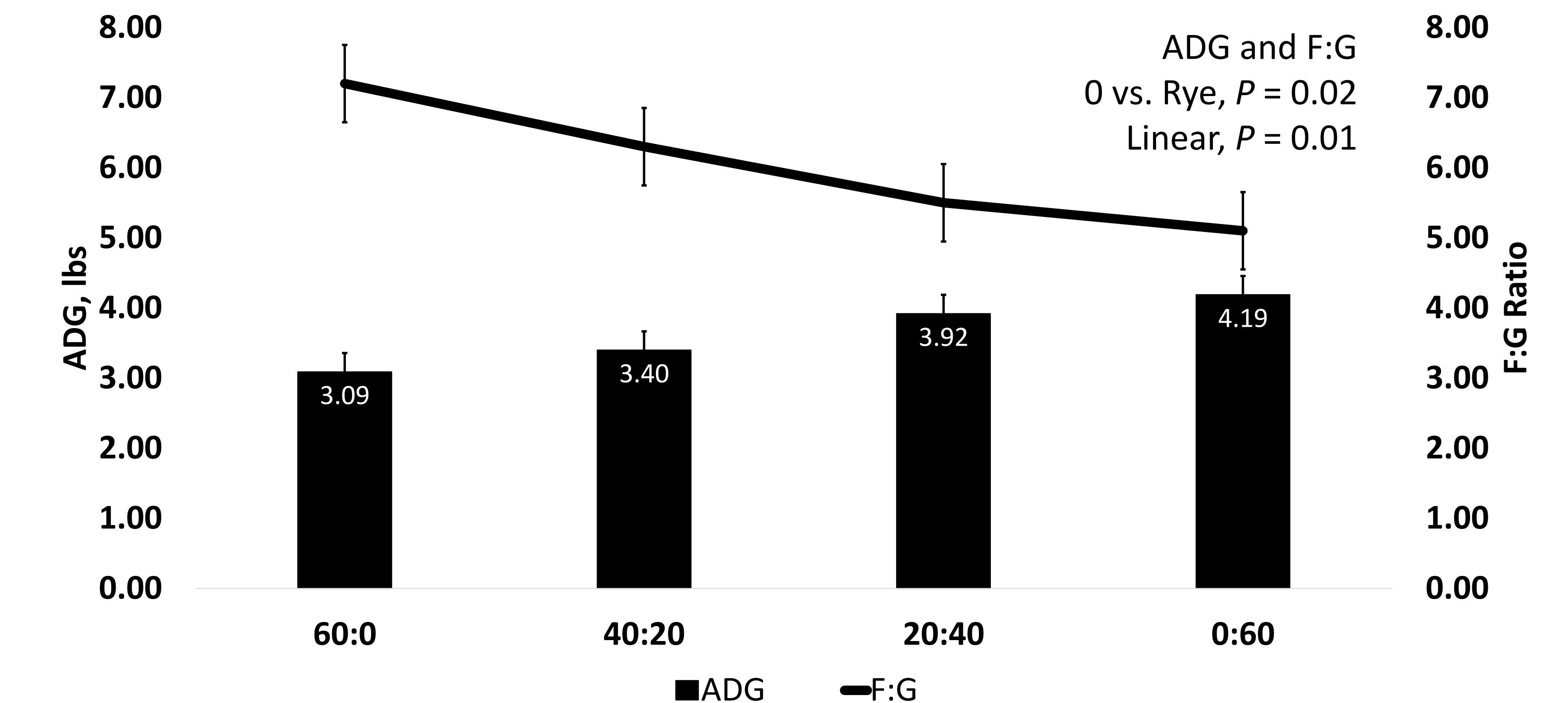
Table 3. Influence of replacing dry-rolled corn (DRC) with Rye grain on carcass traits and liver abscess prevalence in feedlot steers.

	DRC:Rye grain inclusion, % DM basis				SEM	P-value		
	60:0	40:20	20:40	0:60		0 vs. Rye	Linear	Quadratic
Carcass Traits								
End Live BW, lbs ¹	1489	1509	1491	1459	11.4	0.82	0.05	0.04
HCW, lbs	895	892	871	855	6.7	0.01	0.01	0.33
DP, % ²	60.10	59.12	58.42	58.56	0.221	0.01	0.01	0.02
RF, in	0.51	0.51	0.51	0.49	0.014	0.78	0.46	0.55
REA, in ²	12.91	13.12	12.72	12.53	0.155	0.52	0.04	0.22
Marbling	474	478	485	445	11.3	0.74	0.14	0.07
KPH, %	1.79	1.80	1.81	1.79	0.014	0.59	0.71	0.48
YG	3.40	3.32	3.37	3.32	0.063	0.43	0.54	0.85
RY, %	49.67	49.83	49.72	49.82	0.136	0.46	0.60	0.82
EBF, %	30.29	30.19	30.43	29.78	0.253	0.59	0.27	0.29
AFBW, lbs	1321	1320	1281	1279	9.9	0.02	0.01	0.99
YG dist.								
1, %	1.67	0.00	0.00	0.00	0.833	-	-	-
2, %	13.70	23.89	11.67	21.67	5.261	-	-	-
3, %	64.26	64.26	78.33	70.00	8.218	-	-	-
4, %	20.37	11.85	10.00	8.33	5.453	-	-	-
QG dist.								
Select, %	20.56	15.00	13.33	30.00	4.966	-	-	-
Choice, %	50.37	50.93	53.34	48.30	7.590	-	-	-
Premium Choice, %	29.07	34.07	30.00	21.67	6.517	-	-	-
Prime, %	0.00	0.00	3.33	0.00	1.054	-	-	-
Liver Scores								
Normal, %	69.44	74.63	65.00	70.00	4.909	-	-	-
A, %	13.52	5.00	13.33	13.33	4.419	-	-	-
A, %	8.52	10.00	6.67	6.67	3.360	-	-	-
A, %	8.52	10.37	15.00	10.00	4.365	-	-	-

¹ Live BW from d 117 pencil shrunk 4%.

² Calculated as: [(HCW/Shrunk End Live BW) × 100].

Adaptation period ADG and F:G (d 1 to d 18)



Conclusions

- Rye inclusion had no effect on distributions of QG, YG, or liver abscess severity scores.
- Complete replacement of DRC with rye depressed ADG and increased F:G over the full feeding period in this experiment.
- Rye inclusion depressed DMI with the most pronounced effects seen in the last half of the feeding period.
- Comparative NE value of rye is 87.60 and 57.13 Mcal/cwt for maintenance and gain, respectively (84% the tabular NE_G value of DRC).
- Rye could serve as a replacement for DRC in finishing cattle diets depending on relative price differentials and agronomic considerations not measured in this study.

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