Feeding Hybrid Rye as One-third of the Concentrate in Finishing Rations: Two Methods with Improved Results

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Useful as a concentrate in backgrounding rations, hybrid rye can be used successfully as a concentrate in finishing rations. Higher inclusions of hybrid rye reduced performance due to lower net energy for maintenance and gain (NEm and NEg) (Buckhaus et al., 2021; Rusche et al., 2020). Rusche et al. (2020) fed rolled hybrid rye at increasing substitution levels to finishing steers. Steers fed one-third of the concentrate within the ration had similar feed efficiency performance and carcass characteristics as steers fed entirely corn as the concentrate. From day 1-47 of finishing, calves fed hybrid rye one-third and two-thirds of the concentrate within the diet had comparable performance to those fed solely corn as the concentrate. Calves fed two-thirds of their concentrate had reduced gains from day 48-117 but had comparable carcass characteristics (Rusche et al., 2020).

Additionally, as with other concentrates, increased processing by rolling and grinding has shown improvements in animal performance. Grinding hybrid rye tended to improve feed efficiency over dry rolling (Tobin, Evaluation of fine-ground rye, dry rolled hybrid rye, and dry rolled corn in backgrounding steer rations). Due to rapid fermentation and rapid pH level changes, feeding ground small grains as concentrates can lead to acidosis if improperly managed. Increasing substitutions of hybrid rye for barley led to decreases in ruminal pH (Zhang et al., 2023).

The objectives of this experiment were to determine the effectiveness of feeding one-third of the concentrate as hybrid rye for the entire duration of finishing or as a transition diet on dry matter intake (DMI), growth performance and feed efficiency. Our hypothesis is that steers fed a transition diet will have improved performance over the two-thirds and corn control diets.

Materials and Methods

All procedures involving the use of animals in this experiment were approved by the North Dakota State University Institutional Animal Care and Use Committee (approval number IACUC20220074). The experiment was conducted at the North Dakota State University Carrington Research Extension Center (CREC) located near Carrington, ND.

Experimental Design and Treatments

Three treatments were used in a randomized complete block design to evaluate animal performance traits during the finishing phase. Hybrid rye was substituted for DRC in the finishing ration as follows: a basal diet formulated with 68.2% corn grain (CON) on a dry matter (DM) basis with two additional diets formulated at 44.7% corn grain and 23.6% ground hybrid rye (1/3 rye) or 22.5% corn grain and 45.3% ground rye (2/3 rye) (Table 1). After 65 days on feed, the 2/3 ration was transitioned to the control diet for the remainder of the finishing period. Transitioning the 2/3 diet ensured that both hybrid rye rations fed similar amounts of rye grain.

Table 1. Diet forumulations.

Item	Treatment		
	CON	1/3 Rye	2/3 Rye
Ingredient Composition, %			
Dry rolled corn (DRC)	68.3	45.7	22.5
Hybrid rye	0	22.5	45.3
MDGS	19	19	19.3
Corn silage	2.9	2.9	2.9
Barley hay	7	7.1	7.1
Dry supplement	1.5	1.5	1.5
Limestone	1.3	1.3	1.4
Nutrient Composition			
NEm, Mcal/kg	2.25	2.21	2.19
Neg, Mcal/kg	1.36	1.32	1.31
CP, %	13.6	14.2	14.8

Animals, Initial Processing, Study Initiation

One hundred fifty cross-bred steers (765 ± 8 lbs., initial body weight [BW]) were used in this experiment. Steers were consigned to the Dakota Feeder Calf Show (DFCS) from multiple ranches which delivered to the CREC on October 15, 2021. Steers were implanted with Synovex Choice on January 24, 2023.

Steers consigned to the Dakota Feeder Calf Show Feedout project.

Body weights were collected on two consecutive days, averaged for initial body weights, and steers randomly assigned to pen. Steers were fed in eight dirt and seven cement-surfaced pens (*n* = 15; 11 steers/pen), resulting in five replications per treatment with 55 steers per treatment. Calves were housed in pens which had 1 m concrete bunk space, 3.5 m concrete feed apron, and 39.1 m^2 of pen space per steer.

The experiment was initiated on December 27, 2022. Steers transitioned from a high forage backgrounding ration over the first 21 days to their assigned finishing ration and were fed for a total of 155 days.

Diets and Intake Management
Steers were fed once daily at 0800. Steers were placed on a basal high forage backgrounding diet prior to the beginning of the study. Bunks were managed so as to be devoid of feed at 0700 h.

All rye grain was received from a single source and was the same hybrid (KWS Bono, KWS Cereals, LLC; Champaign, IL). Rye was processed by passing through a hammermill. Wet chemistry of the individual ingredients was analyzed at Dairyland Laboratories, Inc (Arcadia, WI) prior to study initiation to balance initial ration. Analysis included ash, ether extract, neutral detergent fiber, acid detergent fiber, and crude protein. Wet chemistry of the total mixed ration was analyzed at Dairyland Laboratories, Inc with similar methods as individual ingredients.

Steers were harvested at a regional abattoir. Carcass characteristics including hot carcass weight (HCW), yield grade (YG), ribeye area (REA), marbling score, and backfat thickness (BF) were recorded.

The monthly average of growth performance (weight, ADG, DMI, GF) were analyzed using the repeated measures procedure of PROC MIXED in SAS 9.4 (SAS Inst Inc., Cary, NC; Littell et al., 2006) with pen serving as the experimental unit. The fixed effects in the model include linear function of month (1 to 6), ration (CON, 1/3 rye, 2/3 rye) and the interaction of month by ration. The subjects repeated measures analysis was pen (1 to 15). Carcass characteristics (hot carcass weight, dressing percentage, yield grade, ribeye area, marbling score, and backfat) were analyzed by PROC MIXED in SAS 9.4. Least squares means were generated using the LSMEANS statement of SAS and treatment effects were evaluated using orthogonal polynomials (Steel and Torrie, 1960). Pre-planned contrasts were analyzed to identify specific differences between CON vs. rye and 1/3 rye vs. 2/3 rye.

Results
There was a treatment tendency for increasing levels of rye to improve overall weight gain over the course of the study ($P = 0.0781$) with calves gaining 540, 564, and 573 when fed the CON, 1/3, and 2/3 rations, respectively. Steers fed rye had higher overall weight gains compared to the corn control ($P = 0.0308$) while no differences in weight were detected between the 1/3 and 2/3 rations due to the inclusion of processed rye in the ration ($P = 0.55$).

No differences in ADG due to the inclusion of processed hybrid rye were detected ($P = 0.28$) throughout the study. No interaction of month by ration ($P = 0.90$) was detected. There was a detected difference due to month ($P < 0.0001$). Across the 155 d study, steers assigned to CON, RRYE, and GRYE had an average daily gain of 3.65, 3.79, and 3.85 lbs., respectively. No differences in ADG were detected among all of the pre-planned contrasts ($P < 0.05$).

Dry matter intake tended to be lower due to the inclusion of processed hybrid rye ($P = 0.0909$) throughout the study. There was a detected difference due to month ($P < 0.0001$). Across the 155 d study, steers assigned to CON, RRYE, and GRYE had an average daily dry matter intake of 24.8, 23.1, and 23.8 lbs. , respectively. Steers fed rye tended to have lower daily intake than steers that were fed the corn control ration ($P = 0.0504$).

The G:F ratio was higher due to the inclusion of rye in the ration ($P = 0.0497$). No interaction of month by ration was detected ($P = 0.77$). There was a detected difference due to month ($P < 0.0001$). Across the 155 d study, steers assigned to CON, RRYE, and GRYE gained 0.15, 0.17, and 0.17 lbs. per lb. of feed consumed, respectively. Throughout the study, steers fed hybrid rye had improved G:F over those fed the corn control ration ($P = 0.0165$).

No differences were detected in HCW, YG, REA, MARB, and BF due to the inclusion of hybrid rye in the ration ($P > 0.05$). Similarly, no differences were detected between corn and rye treatments or between the 1/3 and 2/3 rations.