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Evaluating the Effects of Diet Energy Density on Hereford Steer Performance with Differing Genetic Potential for Dry Matter Intake

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Summary and Implications

Advancements in beef cattle genetics have allowed for development of dry matter intake (DMI) expected progeny differences (EPD). This study was designed to evalute the effects of altered dietary energy density on feedlot performance of steers sired by Hereford bulls in the top and bottom 40% for their breed in DMI EPDs at the time of EPD introduction to the industry in the Spring of 2016. Sire dry matter intake EPD yielded no differences in live animal performance. While steers fed a lower energy diet (0.63 Mcal/lb NEg) had increased DMI and improved average daily gains, steers fed a higher energy diet (0.68 Mcal/lb NEg) had a 6% advantage in feed conversion. As breed associations and producers start to adopt this novel EPD and accurately use the data generated to improve the EPD accuracy, additional research is needed to more fully evaluate the interaction of diet and genetic potential for DMI.

Introduction

Recently, the beef industry has shown an interest in how genetics and nutritional management of feedlot cattle can improve feed efficiency. With this interest has come development of several new EPDs including the American Hereford Association's (AHA) novel DMI EPD. Thus, a study was designed to evaluate if cattle performance could be optimized by altering nutritional management on a group of Hereford steers with known differences in genetic potential for DMI. It was hypothesized that steers sired by bulls with low or negative DMI EPD could be fed a more energy dense diet and maintain similar performance to steers sired by bulls with a high or positive DMI EPD fed a lower energy diet. By knowing the DMI potential of steers, it was anticipated that manipulation of the dietary energy density fed could aid in preventing digestive disturbances such as acidosis while optimizing steer performance and feed resources.

Materials and Methods

In this experiment, 78 purebred Hereford steers were used in a 2 X 2 factorial arrangement based on the animals' genetic potential for DMI EPD and fed one of two diets differing in energy levels (0.63 or 0.68 Mcal/lb NEg, DM basis). Steers were sourced from a single herd and selected based on known Hereford sires (19 sires, 11 low intake sires and 8 high intake sires) with an extreme negative DMI EPD (LOW, -0.30 average sire EPD, n = 33 steers) or positive DMI EPD (HIGH, 0.77 average sire EPD, n = 45 steers) at the time of trial initiation in Spring 2016. The average predicted DMI difference between the HIGH and LOW steers was 1.06 lb/head/day based on sires' AHA EPD as of April 2016.

Prior to arrival at the Iowa State University Beef Nutrition Research Unit (Ames, IA), steers were backgrounded at a commercial feedlot for 4 months and fed a common diet to help reduce maternal effects on subsequent feedlot performance. Upon arrival, steers were housed in 6 head pens with access to feedbunks under roof and allowed to rest for 3 days. Consecutive day initial body weights (BW) were collected, and steers were implanted (Component TE-S, Elanco) on day 0 of test. Steers were penned based on sires with similar DMI EPD in 3-6 head/pen and blocked by BW across pens so that paired pens had similar sire DMI EPD and initial BW. Paired pens with similar DMI EPD were randomly assigned to one of two dietary treatments targeting an *ad libitum* intake: low energy diet (LE; 0.63 Mcal/lb NEg, n = 9 pens) or high energy diet (HE; 0.68 Mcal/lb NEg, n = 9 pens, Table 1).

Interim BW were collected on day 28 and day 56 and consecutive day final BW were collected at the end of the trial (day 85 and 86). Steers were fed a beta-agonist (Optaflexx, Elanco, 300 $\text{mg}\cdot\text{steer}^{-1}\cdot\text{day}^{-1}$) for 29 days prior to harvest at a commercial packing plant (Greater Omaha Packing, Omaha, NE) where individual carcass data were collected. Two steers were removed from the trial due to injury, thus data from those animals were not used in the analysis.

Live animal performance and carcass data were analyzed by ANOVA using the Mixed procedure of SAS (SAS Institute, Inc., Cary, NC) as an incomplete block design with pen as the experimental unit. The model included the fixed effects of dietary treatment, intake classification, the interaction, and block. Significance was declared at $P \leq 0.05$, and tendencies were declared when $P \geq 0.06$ and ≤ 0.15. No interactions of dietary treatment and DMI EPD were observed in live animal performance or carcass data; therefore, only main effects of treatment or EPD will be discussed.

Results and Discussion

Initial BW tended (*P* = 0.11; Table 3) to be lesser in LOW intake steers (956 lb) compared to HIGH intake steers (968 lb). While DMI EPD did not affect ($P \geq 0.26$; Table 3) interim and final BW, final BW tended to be lower (*P* = 0.15; Table 2) for HE-fed steers (1307 lb) compared to LE-fed steers (1331 lb).

Despite an anticipated 1 lb difference in DMI based on sire EPD, DMI was not different (*P* = 0.39; Table 2) between LOW (24.7 lb) and HIGH (24.4 lb) intake steers. However, when updated EPD values were released in December 2016 the gap in sire EPD had narrowed supporting this lack of difference in DMI. In addition, while steers were backgrounded on a common diet to reduce maternal effects, dams' genetic potential for DMI was unknown and may have compromised steers' anticipated DMI. Likewise, the low roughage and higher energy levels commonly found in feedlot diets could have limited steers' ability to express their true genetic DMI potential, and it is unknown if these differences may have been expressed during the backgrounding phase.

No difference ($P \geq 0.39$; Table 3) was observed for average daily gain (ADG) or feed conversion (F:G) across LOW and HIGH intake steers; however, steers fed LE diet had a greater ($P < 0.01$; Table 2) DMI compared to steers fed HE diet (26.2 and 22.9 lb for LE and HE, respectively). Average daily gain tended to be greater (*P* = 0.08) in steers fed LE diet, but F:G was also greater (*P* = 0.03) in LE-fed steers compared to HE-fed steers.

Reflective of the live final BW, HCW was not different ($P \geq 0.33$) across treatments. Ribeye area was also not influenced ($P \geq 0.26$) by diet or DMI EPD. While diet had no impact (*P* = 0.46; Table 4) on marbling score, LOW steers tended to have greater (*P* = 0.06; Table 5) marbling scores (MS) than HIGH steers. This is reflective of difference in sire MS EPD with LOW sires having an average MS EPD of 0.47 opposed to HIGH sires having an average MS EPD of 0.07 as of December 2016. Yield grade and backfat thickness were not influenced by diet ($P \geq 0.45$; Table 4); however, LOW steers tended to have greater yield grades (*P* = 0.14) and increased backfat thickness (*P* = 0.15) compared to HIGH intake steers, suggesting that the LOW intake steers finished more quickly than HIGH steers.

Conclusions

While DMI EPD did not influence steer performance in this study, sire DMI EPD accuracy greatly improved from initial EPD evaluation in April 2016 to December 2016 and narrowed the anticipated gap in DMI from approximately 1.0 lb DM to 0.6 lb DM. As an initial evaluation of the single-parent DMI EPD, changes in sire EPD accuracy altered the ranking of sires after allotment of steers to treatments had already occurred. As such, the study likely had insufficient replication to measure these differences. Dietary energy density did impact live performance with LE-fed steers having greater ADG and increased DMI. However, because of the increased DMI, LE-fed steers also had a less efficient feed conversion. As the beef industry continues to make genetic advancements to improve feed efficiency and additional cattle are evaluated, subsequent research is needed to investigate how nutritional management can optimize cattle performance based on known genetic potential from both the sire and dam side.

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Table 1. Ingredient and nutrient composition of diets

	HE[1]	LE[1]
Dry rolled corn	65.0	57.0
MDGS[2]	25.0	25.0
Bromegrass hay	5.0	13.0
DDGS[3]	3.02	3.02
Limestone	1.5	1.5
Salt	0.31	0.31
Vitamin A premix[4]	0.11	0.11
Trace mineral premix[5]	0.052	0.052
Rumensin90[6]	0.012	0.012

[1] HE = high energy, 0.68 Mcal/lb NEg; LE = low energy, 0.63 Mcal/lb NEg

[2] Modified distillers grains plus solubles

[3] Dried distillers grains plus solubles; carrier for micro-ingredients

[4] Vitamin A premix contained 4,400,000 IU/kg^{-1}

[5] Provided per kg of diet DM: 60 mg Zn (zinc sulfate), 48 mg Mn (manganese sulfate), 17.6 mg Cu (copper sulfate), 0.75 mg I (calcium iodate), 0.24 mg Se (sodium selenite), and 0.38 mg Co (cobalt carbonate)

[6] Provided monensin at 22 g/t of diet (Elanco Animal Health, Greenfield, IN)

Table 2. Influence of diet type on Hereford steer performance

	Diet			
	HE[1]	LE[1]	SEM	*P*-value
Initial BW, lb	961	963	4.93	0.81
28 d BW, lb	1095	1104	6.68	0.40
56 d BW, lb	1204	1214	8.56	0.39
Final BW, lb	1307	1331	11.46	0.15
ADG[2], lb/hd/d	4.06	4.33	0.100	0.08
DMI[3], lbs	22.9	26.2	0.296	<0.01
Feed to Gain	5.69	6.06	0.104	0.03

[1] HE = high energy, 0.68 Mcal/lb NEg; LE = low energy, 0.63 Mcal/lb NEg

[2] Average daily gain

[3] Dry matter intake

Table 3. Influence of dry matter intake (DMI) expected progeny differences (EPD) on Hereford steer performance

	DMI EPD			
	HIGH[1]	LOW[1]	SEM	*P*-value
Initial BW, lb	968	956	5.04	0.11
28 d BW, lb	1105	1093	6.82	0.26
56 d BW, lb	1216	1203	8.74	0.33
Final BW, lb	1323	1314	11.70	0.61
ADG[2], lb	4.18	4.22	0.102	0.76
DMI[3], lb	24.4	24.7	0.303	0.39
Feed to Gain	5.89	5.86	0.106	0.84

[1] HIGH = negative dry matter intake expected progeny differences; LOW = positive dry matter intake expected progeny differences

[2] Average daily gain

[3] Dry matter intake

Table 4. Influence of diet type on Hereford steer carcass characteristics

	Diet			
	HE	LE	SEM	*P*-value
HCW[2], lb	839.8	849.6	6.97	0.33
REA[3], sq. in.	13.17	13.49	0.188	0.26
Marbling score[4]	473	489	15.5	0.46
Backfat thickness, in.	0.67	0.69	0.023	0.47
Yield grade	3.7	3.7	0.06	0.45

[1] HE = high energy, 0.68 Mcal/lb NEg; LE = low energy, 0.63 Mcal/lb NEg

[2] Hot carcass weight

[3] Ribeye area

[4] 300=slight, 400=small, 500=modest

Table 5. Influence of dry matter intake (DMI) expected progeny differences (EPD) on Hereford steer carcass characteristics

	DMI EPD			
	HIGH[1]	LOW[1]	SEM	*P*-value
HCW[2], lb	846.1	843.4	7.12	0.80
REA[3], sq. in.	13.44	13.22	0.192	0.44
Marbling score[4]	457	505	15.8	0.06
Backfat thickness, in.	0.66	0.71	0.023	0.15
Yield grade	3.6	3.8	0.05	0.14

[1] HIGH = negative dry matter intake expected progeny differences; LOW = positive dry matter intake expected progeny differences

[2] Hot carcass weight

[3] Ribeye area

[4] 300=slight, 400=small, 500=modest