The effects of varying implant programs on feedlot growth performance and carcass characteristics of Holstein steers

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INTRODUCTION

Although anabolic implants have been widely studied, implant programs that optimize feeding performance and carcass characteristics for calf-fed Holstein steers remain elusive (Milton et al., 1998). This is in part due to the physiologic and conformational differences between beef and dairy breeds, which makes extrapolating data generated on beef breeds difficult. Typically, dairy breeds have lighter muscling and altered patterns of fat deposition relative to beef breeds (Beckett et al., 2003). Furthermore, dairy breeds are often placed on feed at a lighter weight and fed for twice as long as beef breeds (Scheffler et al., 2003). This study was conducted to evaluate the differences between dose and timing of three implant programs on growth performance and carcass characteristics of calf-fed Holstein steers.

MATERIALS AND METHODS

Study Animals and Location

This study was conducted at a commercial feedyard in Southwest Kansas from April 2015 to July 2016. A total of 7,301 Holstein steers (body weight [BW] = 152 ± 23.0 kg) were purchased from calf ranches in the Texas panhandle, New Mexico, and California. At processing, steers were individually weighed, tagged with duplicate ear tags that contained an individual identification number, treated for the control of parasites (Cydectin Injectable, Boeringer Ingelheim, St. Joseph, MO), vaccinated against viral and bacterial pathogens (Vista 5 SQ, Nasalgen and Covexin 8, Merck Animal Health, Summit, NJ; Presponse Boehringer Ingelheim, St. Joseph, MO), and treated metaphylactically (Micotil, Elanco Animal Health, Greenfield, IN) for the prevention of bovine respiratory disease (BRD). Furthermore, steers were given an anabolic implant based upon their treatment assignment.

Experimental Design

A randomized complete block design with three treatments (Table 1) was used to evaluate the effects of implant program on growth performance and carcass characteristics. Cattle were blocked by time of arrival and randomly allocated into one of three treatment pens at enrollment. There were 10 replications per treatment for a total of 30 pens. Pen served as the experimental unit for all analyses.

Animal Management

Pens of cattle were observed daily for health abnormalities and exceptions were recorded. Steers exhibiting signs of BRD, digestive disturbance, lameness, injury, or other maladies were taken to a hospital facility where furthermore

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evaluation and treatment, if necessary, were performed according to feedyard treatment protocol. Animals that died or were euthanized during the experiment had a field necropsy performed and date of death and diagnosis, when determinable, was recorded.

Steers were group-weighed by pen on a platform scale after study enrollment on day 0 and the morning of shipment to calculate live growth performance. Ship weights were measured prior to daily feed delivery and had a 4% pencil shrink applied to account for rumen fill. Scales were certified within 180 d prior to use in the study. Equal numbers of steers from each pen within block were shipped over 2 d to a commercial abattoir in southwest Kansas. Pens were maintained as lots and cattle within lot were randomly presented for slaughter.

Carcass and Liver Data Collection

Cattle were slaughtered using standard U.S. beef industry practices and United States Department of Agriculture (USDA)/Food Safety Inspection Service inspection criteria. Normal plant procedures were used in handling carcasses throughout the process. Following a standard dressing procedure, hot carcass weight (HCW) was recorded just prior to the final carcass wash and cooler entry. Carcasses were chilled for approximately 36 h prior to being assigned a USDA quality and yield grade.

Carcass data was collected from trained personnel from Garden City Community College (Garden City, KS) that were blinded to treatments. Carcass data was traced back to individual animals through the sequence of individual animal ear tag numbers in the sequence of harvest and plant-assigned carcass identification (ID) sequence. Plant carcass ID and HCW were recorded and verified by carcass sequence number. U.S. Department of Agriculture Quality Grade (assigned by USDA Grader) and Yield Grade (assigned by camera system), HCW, and grading camera measurements were obtained from packing plant records. Dressing percentage for each pen was calculated as the mean hot carcass weight/mean shrunk live weight × 100. Livers were scored for the presence and severity of abscesses and other abnormalities. Severity of liver accesses were scored based upon the Elanco Liver Check Service scoring system (A− = no abscesses or two small abscesses, A = two to four small active abscesses, A+ = multiple small abscesses or one or more large abscesses, A+ Adhesion = liver adhered to the gastrointestinal tract, and A+ Open = open liver abscesses).

Data Management and Analysis

Performance of growth and feed efficiency were calculated on both a mortalities- and removals-included and excluded basis. Data calculated on a mortalities- and removals-included basis accounted for head days associated with dead and removed steers and final weights of cattle removed from the study adjusted with a 4% pencil shrink. The mortalities- and removals-excluded analysis had initial BW and head days removed from calculations based upon average initial BW and days on feed at time of death or removal. It was assumed that dead and removed animals consumed feed at the average of their pen mates and therefore feed intake was not adjusted.

Data was analyzed as a randomized complete block design using ANOVA (Stata 15; Statacorp, College Station, TX) with pen as the experimental unit. The model included fixed effects of treatment and block. Categorical variables such as mortality, animal removal, liver scores, and carcass grade distribution were rank transformed within block and then analyzed with the aforementioned ANOVA.

RESULTS AND DISCUSSION

Implant program did not affect (P = 0.88) morbidity (Table 2) related to respiratory or metabolic disease. However, steers within the Compudose/IS/S implant program had a greater (P < 0.001) incidence of bullers at 6.17% compared with the ES/IS/XS and Encore/S implant programs whose buller rates were 3.44 and 2.79%, respectively.

Mortality was greatest (P = 0.02) in ES/IS/XS steers at 6.98% compared with 5.54% in the Compudose/IS/S and 4.90% in the Encore/S implant programs. However, average days on feed at the time of death was similar (P = 0.20) among treatments and ranged from 152 d in the ES/IS/XS treatment to 168 d in the Compudose/IS/S
treatment. Mortality within each cause of death was similar among implant programs \((P \geq 0.13)\). Increase in mortality of animals implanted with the ES/IS/XS program was an unexpected result and there were no other detectable health maladies due to the implant program. The reported increase in mortality due to the implant program should be interpreted cautiously and may be a Type 1 error.

Performance was calculated on a mortalities- and removals-included and excluded basis (Table 3). In the mortalities- and removals-included analysis, initial BW was similar among treatments \((P = 0.22)\) and steers were on feed for an average of 363 d \((P = 0.21)\). Final BW, ADG, and DMI were similar among treatments \((P \geq 0.11)\). However, feed conversion was improved \((P = 0.01)\) for steers given Encore/S (0.154) compared with those given Compudose/IS/S (0.149 and 0.150, respectively). This difference may be attributed to the numeric increase in ADG and numeric decrease in DMI for the Encore/S implant program. The numerical increase in ADG driven by a numerically higher final BW may be due to a reduced mortality and numerically lower removals by the Encore/S treatment.

In the mortalities- and removals-excluded analysis, steers were on feed for an average of 383 d \((P = 0.39)\). Final BW was greater \((P = 0.01)\) for steers given ES/IS/XS (662 kg) compared with those given Compudose/IS/S (604.7 kg), while dressed yield was unaffected \((P = 0.14)\) by implant treatments. The percentage of carcasses grading Prime tended \((P = 0.06)\) to be greatest for steers given Encore/S (4.29%) and similar between those given ES/IS/XS (2.13%) or Compudose/IS/S (2.12%). The percentage of carcasses grading Choice was greatest \((P < 0.001)\) for steers implanted with Encore/S (69.86%) and similar between steers implanted with ES/IS/XS (63.41%) or Compudose/IS/S (58.40%), while the percentage of carcasses grading Select was reduced \((P < 0.001)\) for steers implanted with Encore/S (22.47%) and similar between the remaining treatments (mean = 32.77%). The percentage of carcasses grading No Roll (i.e., USDA Standard) or below were unaffected \((P \geq 0.32)\) by implant treatment.

Table 2. Animal accountability, mortality, and removals of Holstein steer calves given one of three implant programs

| Item                      | ES/IS/XS | Compudose/IS/S | Encore/S | Probability† |
|---------------------------|----------|----------------|----------|--------------|
| Calves enrolled           | 2,435    | 2,434          | 2,432    |              |
| Morbidity‡, %             | 13.31    | 12.84          | 13.83    | 0.88         |
| Buller, %                 | 3.44a    | 6.17b          | 2.79a    | <0.001       |
| Mortality, %              | 6.98b    | 5.44c          | 4.90d    | 0.02         |
| DOF at death              | 152      | 168            | 165      | 0.20         |
| Removals, %               | 2.62     | 2.49           | 1.92     | 0.87         |
| Transfers||, %           | 1.1      | 2.03           | 1.8      | 0.16         |

*ES/IS/XS = Component ES with Tylan (day 0), Component TE-IS with Tylan (day 50), Revalor-XS (day 170); Compudose/IS/S = Compudose (day 0), Component TE-IS with Tylan (day 160), Component TE-S with Tylan (day 260); Encore/S = Encore (day 0), Component TE-S with Tylan (day 260).

†Categorical data were rank transformed prior to analysis.

‡Animals were pulled for any condition. This percentage represents first pulls; there were no differences between treatments in 2nd and 3rd pull percentages.

||Animals were transferred out of the pen if identification (ear tags) were lost and could not be recovered.

a,bMeans within rows that have unlike superscripts differ \((P < 0.05)\).
The percentage of carcasses classified as heavy (455–476 kg) was reduced ($P = 0.02$) for steers given Encore/S (6.80%) compared with those given ES/IS/XS (9.17%), and steers given Compudose/IS/S (8.14%) were intermediate. However, the more economically important classification of heavyweight carcasses ($\geq$477 kg) was unaffected by treatment ($P = 0.16$).

The percentage of carcasses assigned a Holstein loin score (HL) of 1 (>80.6 cm$^2$ REA) was reduced ($P = 0.01$) for steers given Compudose/IS/S (8.14%) compared with those given ES/IS/XS (9.17%), and steers given Encore/S (8.14%) were intermediate. However, the more economically important classification of heavyweight carcasses ($\geq$477 kg) was unaffected by treatment ($P = 0.16$).

When growth performance was calculated with mortalities and removed cattle included, there was no added benefit from utilizing the ES/IS/XS implant program, which delivered more exogenous hormone than the other implant programs. This was likely due to the increased mortality for ES/IS/XS, which reduced the overall shipped weight and tended to result in lower weight gained ($P = 0.11$) compared with the Encore/S program. Increased mortality associated with ES/IS/XS treatment was an unexpected result and since there were no other maladies detected with this implant program the increased mortality may be a Type I error. The only statistically significant growth performance difference detected when the data included mortalities and removed cattle was improved feed efficiency in the Encore/S implant program.

The ES/IS/XS implant program did exhibit improvements in final BW, total gain, ADG, and F:G over the Compudose/IS/S program when the data excluded mortalities and removals. However, there were no differences detected between the ES/IS/XS and the Encore/S implant program. The ES/IS/XS cattle would appear to have decreased empty body fat at a greater HCW than the Encore/S steers. In today’s marketplace, constraints around Holstein linear size have hampered the ability to feed Holstein steers for a duration (fatter endpoint) that is sufficient to reduce carcass quality grade discounts. While the ES/IS/XS offers a leaner carcass at a heavier weight, an Encore/S may prove to be a treatment of choice in managing Holstein carcass quality, carcass weight, and presumably size, with similar feed efficiency. If treatments were taken to a comparable composition endpoint, the ES/IS/XS would need to be fed longer to attain similar fatness of the Encore/S cattle and would therefore have additional HCW, but feed efficiency would be

### Table 3. Finishing performance of Holstein steer calves given one of three implant programs

| Item                        | ES/IS/XS | Compudose/IS/S | Encore/S | SEM | Probability |
|-----------------------------|----------|----------------|----------|-----|-------------|
| Mortalities and removals included |          |                |          |     |             |
| DOF                         | 360.2    | 363.2          | 365.1    | 1.86| 0.21        |
| Initial BW, kg              | 151      | 152            | 151      | 0.57| 0.22        |
| Final BW, kg                | 610      | 612            | 621      | 4.17| 0.15        |
| ADG, kg/d                   | 1.27     | 1.27           | 1.29     | 0.008| 0.16        |
| DMI, kg/d                   | 8.46     | 8.51           | 8.37     | 0.048| 0.14        |
| G:F                         | 0.150b   | 0.149b         | 0.154a   |     |             |
| Mortalities and removals excluded |        |                |          |     |             |
| DOF                         | 383      | 383            | 383      | 0.06| 0.39        |
| Initial BW, kg              | 151      | 152            | 151      | 0.57| 0.22        |
| Final BW, kg                | 662b     | 653b           | 658a     | 1.83| 0.01        |
| ADG, kg/d                   | 1.33b    | 1.31a          | 1.32b    | 0.005| 0.01        |
| DMI, kg/d                   | 8.46     | 8.51           | 8.37     | 0.048| 0.14        |
| G:F                         | 0.158b   | 0.153b         | 0.158b   |     |             |

*ES/IS/XS = Component ES with Tylan (day 0), Component TE-IS with Tylan (day 50), Revalor-XS (day 170); Compudose/IS/S = Compudose (day 0), Component TE-IS with Tylan (day 160), Component TE-S with Tylan (day 260); Encore/S = Encore (day 0), Component TE-S with Tylan (day 260).

a,bMeans within rows that have unlike superscripts differ ($P < 0.05$).
sacrificed. Interestingly, treatment with Encore/S resulted in fatter carcass composition with similar feed efficiency compared with ES/IS/XS. This might be the result of estrogen-only exposure for a greater duration and would imply that trenbolone acetate (TBA) in Holsteins may not be warranted until the end of the feeding period. Other reports conducted on Holstein steers showed that the use of estrogenic implants early in the feeding period followed by a terminal implant containing TBA resulted in similar live performance to implant programs containing TBA only (Milton et al., 1998; Zinn et al., 1999; Beckett et al., 2003). Furthermore, using estrogenic implants initially improved carcass quality grade compared with the TBA-only programs.

Implant program did not affect the percentage of carcasses with yield grades 4 and 5; however, the Compudose/IS/S treatment had a greater proportion of yield grade 1 steers relative to the other implant programs. The Compudose/IS/S steers also had the lowest percentage of Choice carcasses. The intricacies around HCW, quality and yield grade distributions bring into question the importance of overall implant dose and timing of dose, particularly for TBA in Holsteins.

In the current study, use of the ES/IS/XS implant program resulted in greater ADG and HCW; however, most of these benefits were negated due to the increased death loss. Use of the Encore/S resulted in improved quality grades, while the Compudose/IS/S program resulted in more desirable yield grades. These results indicate that the long-acting implant Encore followed by a Component TE-S improves quality grade without sacrificing live performance, while the ES/IS/XS program improves HCW.

Conflict of interest statement. None declared.
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