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Impact of Sorting Prior to Feeding Zilpaterol Hydrochloride on Feedlot Steers

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Summary

Crossbred yearling steers (n = 1000; 755 ± 23 lb) were utilized to evaluate effects of sorting and feeding zilpaterol hydrochloride (Zilmax®) on feedlot performance, carcass characteristics, and economics. Treatments were: unsorted negative control (–CON); unsorted Zilmax fed positive control (+CON); and three treatments where the heaviest 20% of steers within the pen were identified at beginning (EARLY), 100 days from harvest (MIDDLE), or 50 days from harvest (LATE) and marketed 28 days earlier. Dry matter intake was not different. Gain and G:F were improved by feeding Zilmax. Carcasses from the +CON and steers sorted EARLY, MIDDLE, and LATE were 61, 56, and 53 lb heavier than –CON, respectively. Fat depth and marbling were lower for +CON compared to –CON, but feeding Zilmax with any of the sorting treatments improved marbling to equal –CON.

Introduction

Zilpaterol hydrochloride (Zilmax) is an approved, orally-active ß-adrenergic receptor agonist that improves feed efficiency and increases carcass leanness in cattle fed in confinement for slaughter (*Journal of Animal Science, 2010,* 88:2825). Studies conducted using feedlot steers fed corn-based diets in the U.S. have demonstrated feeding Zilmax for the last 20 days prior to slaughter resulted in increased ADG, improved F:G, increased carcass weight, and increased carcass leanness compared to cattle not fed Zilmax (*Journal of Animal Science*, *2009,* 87:2133). It has also been shown that feeding Zilmax reduces USDA choice grades about 10 percentage units compared to cattle not fed Zilmax. Previous research indicates that sorting cattle allows pens of cattle to be fed longer without causing a dramatic increase in overweight discounts (*1999 Nebraska Beef Cattle Report,* p. 71) and that profits for sorted cattle are greater than unsorted cattle due to overweight discounts for unsorted cattle (*2009 Nebraska Beef Cattle Report,* p. 92).

The objectives of the current study were to evaluate effects on performance, carcass characteristics and econmics of sorting and feeding Zilmax.

Procedure

Experiment

Crossbred yearling steers (n = 1,000; 755 ± 23 lb initial BW) were assigned randomly to one of 40 pens within three arrival blocks (25 steers/pen) to evaluate sorting and feeding Zilmax. The five treatments included an unsorted negative control (–CON), unsorted Zilmax fed positive control (+CON); and three treatments where the heaviest 20% within the pen were sorted and marketed 28 days early and the remaining 80% were fed Zilmax. The 20% were identified at the beginning (EARLY), 100 days from slaughter (MIDDLE), or 50 days from slaughter (LATE) by weighing steers individually.

Steers were fed Zilmax (Zilpaterol hydrochloride 4.8%, Intervet/Schering-Plough Animal Health, De Soto, Kansas) at 7.56 g/ton DM for 20 days followed by a three-day withdrawal. Basal diet and supplement ingredients are presented in Table 1. Feed refusals were collected when accumulation occurred and were subsequently weighed and dried in a forced air oven at 60°C for 48 hours to calculate DMI.

Table 1. Basal diet and supplement (finishing ration).

Ingredient	% of diet DM
Basal Diet	
DRC	25.0
HMC	25.0
Sweet Bran	40.0
CornStalks	5.0
Supplement	5.0
Supplement	
Fine ground corn	2.94
Limestone	1.57
Salt	0.28
Tallow	0.12
Trace mineral	0.05
Rumensin-90	0.02
Tylan-40	0.01
Vitamin A,D,E	0.02

Two supplements were manufactured and fed during the study. One supplement contained Zilmax, and one supplement did not contain any Zilmax. In the supplement containing Zilmax, Zilmax replaced fine ground corn.

Steers in block one arrived at the feedlot in October and November 2009. Steers in blocks two and three were sourced from two auction markets 12 days and eight days prior to allocation to the study, respectively. All steers were implanted with Revalor-XS®at trial initiation. Prior to the start of the experiment, steers were limit fed a common diet at 2.0% of BW for five consecutive days to minimize variation in body weight due to gut fill. Following the limit feeding period, steers were randomly alloted to pen and pens were randomly allotted to treatment. The heaviest 20% of steers in each pen in the EARLY treatment were identified during weighing and processing on day 1. Cattle were fed *ad libitum* twice daily.

One hundred days prior to the target marketing date steers from pens in the MIDDLE group within a block were individually weighed to identify the heaviest 20% of steers. Fifty days prior to the target marketing date steers from pens in the LATE group within a block were individually weighed to identify the heaviest 20% of steers. Within a block, the heaviest

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Table 2. Performance data summary.

	Treatment							Contrasts		
		Zilmax Fed								
Variable	–CON	+CON	EARLY	MIDDLE	LATE	SEM	*P*-value	–CON vs. +CON	+CON vs. E,M,L	–CON vs. E,M,L
Pens	8	8	8	8	8					
Steers	200	200	200	200	200					
Average days[1]	167	167	176	176	176					
Live Performance[2]										
Initial BW, lb	757	746	761	761	756	6.8	0.52	0.26	0.10	0.76
Final BW, lb	1409[b]	1425[b]	1485[a]	1468[a]	1479[a]	8.7	<0.01	0.20	<0.01	<0.01
DMI, lb/day	25.6	25.2	25.8	25.7	25.6	0.2	0.32	0.18	0.04	0.64
ADG, lb	3.93[b]	4.09[a]	4.15[a]	4.05[a,b]	4.14[a]	0.05	0.03	0.03	0.68	<0.01
F:G	6.56[a]	6.17[b]	6.24[b]	6.38[a,b]	6.22[b]	0.09	0.03	<0.01	0.26	0.01
Carcass[3] ADG, lb	2.74[b]	2.95a	2.95[a]	2.91[a]	2.91[a]	0.03	<0.01	<0.01	0.39	<0.01

[1]DOF for Block 1 +CON and –CON was 158, for heaviest 20% of sorted treatments was 141 and for the remaining 80% was 171. DOF for Block 2 +CON and –CON was 166, for heaviest 20% of sorted treatments was 153 and for the remaining 80% was 182. DOF for Block 3 +CON and –CON was 169, for heaviest 20% of sorted treatments was 153 and for the remaining 80% was 183.
[2]Live performance values were calculated using Dressing % and Hot Carcass Weight to calculate Live Weight prior to slaughter.
[3]Carcass adjusted performance values were calculated using carcass weights obtained at slaughter and live weights at allocation converted to carcass initial weight using a Dressing Percentage of 56.8% based on May et al., 1992.
[4]Average Dressing Percentage for Block 3 (3 replicates for treatments EARLY, MIDDLE, and LATE) was 64.2%. Therefore, all Zilmax fed cattle were assigned a Dressing Percentage of 64.2%. All cattle sold early as part of the heaviest 20% had a measured Dressing Percentage. Based on Elam et al., 2009, a 1.36% reduction was applied to the Dressing Percentage for cattle not fed Zilmax, resulting in a Dressing Percentage of 62.8%.
[a,b,c]Means with different superscripts differ ($P < 0.05$).

Table 3. Carcass characteristic data summary

	Treatment							Contrasts		
		Zilmax Fed								
Variable	–CON	+CON	EARLY	MIDDLE	LATE	SEM	*P*-value	–CON vs. +CON	+CON vs. E,M,L	–CON vs. E,M,L
HCW, lb	886[c]	915[b]	947[a]	942[a]	939[a]	5.4	<0.01	<0.01	<0.01	<0.01
Change in HCW[3], lb	0	29	61	56	53	—	—	—	—	—
HCW C.V[2], lb	7.5	9.0	6.6	6.2	6.2	—	—	—	—	—
HCW Std. Dev, lb	67[b]	82[a]	63[b]	58[b]	58[b]	4.1	<0.01	0.01	<0.01	0.16
HCW Over 950 lb, %	17.30[b]	36.22[a]	47.93[a]	46.18[a]	41.55[a]	4.24	<0.01	<0.01	0.07	<0.01
HCW Over 1,000 lb, %	6.32[b]	13.80[a,b]	18.34[a]	16.97[a]	16.43[a]	2.95	0.05	0.08	0.32	<0.01
HCW Over 1,050 lb, %	0.94	5.42	5.42	2.94	4.44	1.34	0.11	0.02	0.46	0.04
12th Rib Fat, in	0.59	0.55	0.57	0.58	0.59	0.01	0.10	0.02	0.02	0.54
12th Rib Fat S.D, in	0.15	0.15	0.15	0.16	0.15	0.00	0.88	0.81	0.75	0.99
LM Area, in[2]	14.00[b]	15.13[a]	15.12[a]	15.08[a]	14.95[a]	0.12	<0.01	<0.01	0.57	<0.01
Marbling Score[4]	567[a]	544[b]	575[a]	567[a]	570[a]	5.12	<0.01	<0.01	<0.01	0.60
Marbling Score S.D.	87	76	91	86	80	5.03	0.25	0.12	0.11	0.73

[1]Average Dressing Percentage on Block 3 (3 replicates for treatments EARLY, MIDDLE, and LATE) was 64.2%. Therefore, all Zilmax fed cattle were assigned a Dressing Percentage of 64.2%. All cattle sold early as part of the heaviest 20% had a measured Dressing Percent. Based on Elam et al., 2009, a 1.36% reduction was applied to the Dressing Percentage for cattle not fed Zilmax resulting in a Dressing Percentage of 62.8%.
[2]HCW is hot carcass weight, C.V. is coefficient of variation and is calculated by dividing the Standard Deviation by the Mean and is expressed as a percentage.
[3]Change in HCW is the difference between the HCW in each treatment and –CON.
[4]Marbling Score 600 = Modest, 500 = Small, 400 = Slight.
[a,b,c]Means within a row with different superscripts differ ($P < 0.05$).

20% of steers in the Zilmax sorted treatments were sorted from their pen mates, weighed by pen, and shipped for slaughter 28 days before the remainder of the pen was scheduled for shipment.

Steers were harvested at a commercial abattoir. Liver scores and HCW were collected on the day of slaughter. Following a 48-hour chill, marbling score, 12th rib fat depth, and LM area were recorded. A calculated dressing percentage was used to calculate carcass adjusted performance to determine final BW, ADG, and F:G. Carcass ADG was calculated assuming a 56.8% dressing percentage for all steers at trial initiation (*Journal of Animal Science*, 1992, 70:444).

Economics

Profitability was examined using live, carcass, and grid based pricing. Purchase price was set such that the average profit of the –CON was zero, which was $0.9855/lb.

Yardage was charged at a rate of $0.45 per steer per day, interest rate was estimated at 6.5%, and the health

Table 4. Yield and quality grade data summary.

	Treatment							Contrasts		
		Zilmax Fed								
Variable	–CON	+CON	EARLY	MIDDLE	LATE	SEM	*P*-value	–CON vs. +CON	+CON vs. E,M,L	–CON vs. E,M,L
USDA Yield Grade[1]										
1	3.70	5.60	7.64	6.10	3.10	1.61	0.28	0.41	0.99	0.31
2	23.95[b]	39.18[a]	26.31[b]	26.51[b]	28.85[b]	2.93	<0.01	<0.01	<0.01	0.34
3	53.68	44.78	50.03	53.76	50.49	4.36	0.59	0.16	0.20	0.66
4	16.63	8.94	16.03	13.13	15.55	2.53	0.21	0.04	0.05	0.56
5	2.10[a]	0.55[b]	0.05[b]	0.05[b]	1.08[a,b]	0.51	0.04	0.04	0.79	<0.01
USDA Quality Grade[1]										
Prime	2.94	0.42	2.94	1.44	1.44	0.95	0.28	0.07	0.17	0.37
Choice+	5.15	2.11	8.15	6.67	5.65	1.57	0.11	0.18	0.01	0.36
Choice0	24.82	19.11	24.21	24.38	27.23	2.48	0.24	0.11	0.04	0.87
Choice-	46.84	49.88	43.09	46.84	48.09	3.75	0.77	0.57	0.38	0.85
Select	20.32	27.05	19.66	19.74	17.16	2.71	0.14	0.09	0.01	0.64
Standard	0.00	0.47	0.47	0.47	0.00	0.37	0.70	0.35	0.70	0.44
Choice and above	79.74	71.52	78.39	79.33	82.41	2.78	0.10	0.04	0.01	0.93
Select and below	20.29	27.52	20.12	20.21	17.12	2.67	0.10	0.06	0.01	0.71

[1]The Yield Grade (YG) and Quality Grade (QG) values represent the proportion of carcasses within each group that received each YG or QG and are expressed as percentages.
[a,b]Means within a row with different superscripts differ ($P < 0.05$).

and processing fee was $25.00 per steer. Death loss was 0.60%. Sale price used was the price received from the packing plant at the time of sale. Corn was priced at $6.50/bu, Sweet Bran® was priced at 90% the price of corn (DM basis), and corn stalks were priced at $86.00/ton. Total diet cost was $253.65 per ton DM.

Grid price was calculated using an average dressed price of $1.70/lb. Premiums were awarded for upper 2/3rd choice ($3.00) and Prime ($8.00), as well as Yield Grade 1 ($5.50) and 2 ($3.50). Discounts were given for Select (-$8.56) and Standard (-$12.75) carcasses, as well as Yield Grade 4 (-$10.00) and 5 (-$16.25), as well as for overweight carcasses (-$10.00 for carcasses over 950 lb and -$20.00 for carcasses over 1,000 lb).

Statistical Analysis

Both performance and economic data were analyzed as a randomized complete block design using the MIXED procedure of SAS (SAS Inst., Inc., Cary, N.C.). The analysis included the following preplanned contrasts: –CON vs. +CON, –CON vs. EARLY, MIDDLE, and LATE, +CON vs. EARLY, MIDDLE, and LATE. Steers were blocked by arrival group and pen was the experimental unit. Block and treatment were included in the model as fixed effects. Although the heaviest 20% of steers were shipped for slaughter early, they were included in the analysis with pen as the experimental unit.

Results

Due to the weight sort, steers in the Zilmax sorted treatments were fed an average of 14 days longer than the control treatments (Table 2). Steers fed the +CON had 16 lb heavier ($P < 0.01$) final BW than steers fed the –CON control. Steers sorted EARLY, MIDDLE, and LATE were 76, 59, and 70 lb heavier ($P < 0.01$) than –CON. Intake was not different among the five treatments. Gain was greater ($P < 0.05$) and F:G improved ($P < 0.03$) for the +CON than the –CON, but was not different among steers that received Zilmax.

Carcasses from steers fed the +CON were 29 lb heavier ($P < 0.01$) than –CON. Carcasses from steers sorted EARLY, MIDDLE, and LATE were 61, 56, and 53 lb heavier ($P < 0.01$) than –CON (Table 3). Standard deviation in carcass weight was greater ($P = 0.01$) for +CON than –CON, but was not different ($P = 0.16$) between –CON and Zilmax sorted treatments. The percentage of carcasses over 950 lb was greater ($P < 0.01$) for the +CON than the –CON (36.22% vs. 17.30%), and was greater ($P < 0.01$) for the sorted treatments than the –CON (average of 45.22% vs. 17.30%). The percentage of carcasses over 1,000 lb was greater ($P = 0.05$) in sorted treatments (average of 17.25%) than –CON (6.32%). The percentage of carcasses over 1,050 lb was not different ($P = 0.11$) among treatments. Thus, sorting was not effective in reducing the percentage of overweight carcasses when overweight discounts are applied at 950 or 1,000 lb due to the additional 14 days. Fat depth and marbling score were lower ($P < 0.02$) in +CON than –CON, but not different between –CON and sorted treatments suggesting the extra 14 days allowed for fatness to be equalized when feeding Zilmax. Longissimus muscle area was greater ($P < 0.01$) in +CON than –CON, but was not different ($P = 0.57$) between +CON and sorted treatments. Marbling score was lower ($P < 0.01$) for +CON than –CON.

The percentage of USDA Yield Grade 2 carcasses was greater ($P < 0.01$) for the +CON than the –CON and the Zilmax sorted treatments, but was not different between the –CON and the sorted treatments (Table 4). The percentage of USDA

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Table 5. Economic analysis summary.

	Treatment							Contrasts		
		Zilmax Fed								
Variable	–CON	+CON	EARLY	MIDDLE	LATE	SEM	*P*-value	–CON vs. +CON	+CON vs. E,M,L	–CON vs. E,M,L
B/E[1] ($/head)	100.43	99.88	99.58	100.44	99.43	±0.47	0.43	0.42	0.91	0.27
COG[2] ($/head)	97.81	96.28	95.66	97.26	95.41	±1.00	0.32	0.26	0.87	0.12
COP[3] ($/head)	1414.44[b]	1423.05[b]	1477.58[a]	1473.89[a]	1470.11[a]	±8.46	<0.01	0.47	<0.01	<0.01
Live P/L[4] ($/head)	0.00	10.02	19.51	6.43	21.49	±7.79	0.27	0.36	0.52	0.09
Carcass P/L[4] ($/head)	0.00[b]	39.74[a]	40.38[a]	35.96[a]	35.21[a]	±7.08	<0.01	<0.01	0.76	<0.01
Grid P/L[4] ($/head)	0.00[b]	34.48[a]	29.62[a]	25.70[a]	24.52[a]	±8.30	0.05	<0.01	0.42	<0.01

[1]B/E is break even=(initial steer cost + feed cost + interest + health and processing + yardage + death loss)/ final weight.
[2]COG is cost of gain=(feed cost + interest + health and processing + yardage + death loss)/(final weight- initial weight).
[3]COP is cost of production=initial steer cost + feed cost + health and processing + yardage + interest + death loss.
[4]P/L is profit/loss= final steer value- (initial steer cost + feed cost + interest + health and processing + yardage + death loss) with initial steer cost set such that profit of the –CON on average was 0.
[5]Diet cost was $253.65/ton, feed cost included the cost of Zilmax ($20.00 per head) when Zilmax was fed.
[a,b,c]Means within a row with different superscripts differ ($P < 0.05$).

Yield Grade 5 carcasses was greater ($P < 0.04$) for the –CON than the +CON and the sorted treatments, but was not different between the +CON and the sorted treatments. No differences in quality grade were observed ($P > 0.10$). Zilmax in combination with a weight sort to identify heavy carcasses increased carcass weight without increasing variation in carcass weight, and allowed for cattle to reach an optimum fat endpoint.

Economics

Economics were calculated for three different scenarios: 1) cattle sold on a live basis, 2) cattle sold on a carcass (or dressed) basis and 3) cattle sold on a grid basis. In order to calculate the marginal rate of return, the initial price was set such that the profits of the –CON were equal to zero (Table 5).

Total cost of production was greater ($P < 0.01$) for the Zilmax sorted treatments compared to the –CON and compared to the +CON, but was not different between the –CON and +CON. On average, the sorted cattle had an additional cost of $50.81 over the +CON and $59.42 over than the –CON. Breakeven cost and cost of gain were not different among treatments.

When steers were sold on a live basis, profits were not different among treatments. When steers were sold on a carcass basis, profits were $37.83/head greater ($P < 0.01$) for the Zilmax fed treatments compared to the –CON. Profits on a carcass basis were not different between the +CON and Zilmax sorted treatments. When steers were sold on a grid basis, profits were $28.58/head greater ($P = 0.05$) for Zilmax fed steers compared to the –CON. Profits on a grid basis were not different between the +CON and Zilmax sorted treatments. Profits on a grid basis were $9.25/head lower on average than carcass-based profits due to the overweight carcass discounts as sorting was not effective in reducing the percentage of overweight carcasses.

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