Effects of Extended Zilpaterol-HCl Withdrawal on Performance and Carcass Traits of Finishing Beef Heifers

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Introduction

Zilpaterol-HCl (Zilmax; Intervet/Schering-Plough Animal Health, Millsboro; DE) is an orally active β_2-adrenergic agonist that is approved for use in feedlot cattle at the rate of 7.56 g/ton of diet dry matter for the final 20 to 40 days on feed. The minimum withdrawal time for Zilmax is 3 days. Zilmax increases hot carcass weight and dressing percentage, primarily as a result of increasing lean muscle mass and decreasing body fat. Zilmax also decreases marbling and increases shear-force values (i.e., less tender) of steaks. This study was conducted to determine whether the benefits of Zilmax would be retained with longer withdrawal times while overcoming undesirable effects on shear force and marbling.

Experimental Procedures

Crossbred heifers (n = 450; initial body weight = 1,025 ± 59 lb) were blocked into two groups on the basis of initial body weight. A total of 54 feedlot pens were used. Partially covered concrete pens, uncovered concrete pens, and dirt-surfaced pens were used in this study. Replicates within weight blocks were balanced according to pen type. Treatments were arranged in a 2 × 3 factorial arrangement. Factors were Zilmax (0 or 7.56 g/ton diet dry matter; Table 1) and withdrawal times of 3, 10, or 17 days. Zilmax was fed for 20 days. Cattle were fed free choice once daily and had access to clean, fresh water from a municipal source. Within weight block, Zilmax was initiated on the same day so all cattle would have a similar degree of fatness at the start of Zilmax feeding.

On the morning of shipment, cattle were weighed and then transported to Tyson Fresh Meats in Holcomb, KS. Paired groups of control and Zilmax-fed cattle were harvested on the same day. Animal performance measurements included average daily gain, dry matter intake, and feed:gain. Hot carcass weight and liver abscess were collected immediately following harvest. After a 48-hour chill, USDA yield and quality grades; percentage of kidney, pelvic, and heart fat; 12th rib fat thickness; ribeye area; marbling score; and lean color score were recorded for each carcass. Dressing percentage was calculated as hot carcass weight divided by shrunk final body weight.

Loins were collected from 15 animals per treatment on each harvest day. Approximately equal numbers of USDA Choice and Select loin sections were retained from each treatment. The loins were wet aged in vacuum-packaged bags for 7, 14, and 21 days after harvest. Steaks were cut and frozen at each aging time to terminate the aging process, and frozen steaks stored until shear-force measurements were made. To determine shear force, loin steaks were cooked in an oven to an internal temperature of

[1] Intervet, Inc., Millsboro, DE.

160°F. Cooked steaks were allowed to cool overnight in a refrigerator. Six core samples were drilled from each steak, and shear-force values were determined with an Instron machine (Instron, Norwood, MA).

Results and Discussion

Zilmax had no effect ($P>0.64$) on final body weight, average daily gain, or feed intake of heifers (Table 2) but tended to improve feed efficiency ($P<0.11$). Zilmax increased hot carcass weights by 27, 17, and 11 lb following 20 days of feeding and withdrawal times of 3, 10, and 17 days, respectively (Table 3). Dressing percentages were greater ($P<0.01$) for heifers fed Zilmax. Ribeye areas increased with Zilmax feeding ($P<0.01$). Zilmax did not affect 12th rib fat thickness, but fat thicknesses increased with extended withdrawal times ($P<0.03$), presumably because heifers were fed longer. Increased withdrawal times resulted in less kidney, pelvic, and heart fat ($P<0.01$). There were no differences ($P=0.96$) in liver abscesses were noted.

Zilmax improved USDA yield grades when withdrawn for 3 or 10 days, but improvements were no longer evident after 17 days of withdrawal (Zilmax × withdrawal time, $P=0.06$; Table 4). Zilmax decreased ($P<0.05$) the percentage of yield grade 3 carcasses.

Zilmax decreased marbling scores ($P<0.01$; Table 5), and these negative effects were partially overcome with extended withdrawal times ($P=0.04$). Zilmax increased the percentage of cattle grading USDA Standard and Select and decreased the percentage of carcasses grading USDA Choice ($P<0.10$). Improvements in carcass quality were achieved by extending the posttreatment withdrawal time.

Heifers fed Zilmax had increased shear-force values ($P>0.01$; Table 6), but increasing Zilmax withdrawal times had no effect ($P=0.31$) on shear-force values. Previous research indicated that shear-force values became acceptable by wet aging steaks for 14 days or longer. In this study, steaks from Zilmax-treated heifers showed greater (aging × Zilmax, $P<0.05$) improvements in shear-force values than steaks from control heifers as wet aging time increased.

Implications

Feeding Zilmax increased hot carcass weights and dressing percentage but decreased marbling scores and increased shear-force values of loin steaks. The effects of Zilmax were less pronounced with longer withdrawal times. Aging loins for 14 days or more resulted in acceptable tenderness.

Table 1. Ration composition (% of diet dry matter)

	Treatments	
Ingredient, %	Control	Zilmax
Steam-flaked corn	80.5	80.5
Alfalfa hay	6.0	6.0
Corn steep liquor	8.0	8.0
Control supplement[1]	3.3	---
Zilmax supplement[2]	---	3.3
Feed additive premix[3]	2.23	2.23

[1] Control supplement was formulated to provide 0.1 ppm cobalt; 10 ppm copper; 0.6 ppm iodine; 60 ppm manganese; 0.25 ppm selenium; 60 ppm zinc; 1,200 IU/lb vitamin A; and 10 IU/lb vitamin E in the total diet dry matter.

[2] Zilmax supplement was formulated to provide 0.1 ppm cobalt; 10 ppm copper; 0.6 ppm iodine; 60 ppm manganese; 0.25 ppm selenium; 60 ppm zinc; 1,200 IU/lb vitamin A; 10 IU/lb vitamin E; and 7.56 g/ton zilpaterol-HCl in the total diet dry matter.

[3] Feed additive premix was formulated to provide 300 mg Rumensin (Elanco Animal Health; Greenfield, IN), 90 mg Tylan (Elanco Animal Health), and 0.5 mg MGA (Pfizer Animal Health; New York, NY) per heifer daily in a ground corn carrier.

Table 2. Effects of Zilmax and extended withdrawal times on performance of finishing heifers

	3-day withdrawal		10-day withdrawal		17-day withdrawal			P-values[1]		
Item	Control	Zilmax	Control	Zilmax	Control	Zilmax	SEM	Zilmax	Withdrawal	W × Z
Initial weight, lb	1029	1035	1032	1032	1032	1031	57.94	0.68	0.99	0.73
Pre-Zilmax weight, lb	1187	1191	1194	1184	1190	1189	8.83	0.81	0.99	0.74
Final weight, lb	1215	1229	1241	1243	1268	1265	19.04	0.64	0.01	0.72
Average daily gain, lb	2.81	2.95	2.91	2.97	2.98	2.97	0.17	0.54	0.75	0.81
Feed intake, lb	19.05	18.98	19.47	18.63	19.30	19.02	0.92	0.16	0.91	0.50
Feed:Gain	6.78	6.43	6.69	6.27	6.47	6.41	0.28	0.11	0.74	0.71

[1] W × Z, Interaction between withdrawal and Zilmax.

Table 3. Effects of Zilmax and extended withdrawal times on carcass characteristics of finishing heifers

	3-day withdrawal		10-day withdrawal		17-day withdrawal			P-values[1]		
Item	Control	Zilmax	Control	Zilmax	Control	Zilmax	SEM	Zilmax	Withdrawal	W × Z
Carcass weight, lb	775	803	798	815	798	815	7.6	0.01	0.01	0.54
Dressing percentage	63.78	65.34	64.34	65.56	64.34	65.56	0.72	0.01	0.13	0.70
Backfat, in.	0.43	0.44	0.46	0.40	0.46	0.40	0.06	0.16	0.03	0.34
Kidney, pelvic, and heart fat, %	2.13	2.25	2.00	1.98	2.00	1.98	0.06	0.57	0.01	0.33
Ribeye area, sq. in.	13.7	14.8	13.6	14.6	13.6	14.6	0.59	0.01	0.25	0.64
Liver abscess, %	3.17	2.22	4.29	5.40	4.29	5.40	0.96	0.96	0.43	0.90

[1] W × Z, Interaction between withdrawal and Zilmax.

Table 4. Effects of Zilmax and extended withdrawal times on USDA yield grade of finishing heifers

	3-day withdrawal		10-day withdrawal		17-day withdrawal			P-values[1]		
Item	Control	Zilmax	Control	Zilmax	Control	Zilmax	SEM	Zilmax	Withdrawal	W × Z
USDA yield grade	2.3	2.16	2.46	2	2.37	2.38	0.18	0.02	0.23	0.06
Yield grade 1, %	13.2	22.9	11. 5	27.3	18.0	8.9	0.05	0.17	0.45	0.04
Yield grade 2, %	45.5	42.8	40.2	46.3	31.6	47.9	0.08	0.18	0.73	0.27
Yield grade 3, %	38.9	29.7	38.8	25.1	47.2	39.0	0.08	0.05	0.19	0.90
Yield grade 4 and 5, %	2.4	4.6	9.5	1.3	3.1	4.2	0.04	0.41	0.69	0.07

[1] W × Z, Interaction between withdrawal and Zilmax.

Table 5. Effects of Zilmax and extended withdrawal times on USDA quality grade of finishing heifers

	3-day withdrawal		10-day withdrawal		17-day withdrawal			P-values[1]		
Item	Control	Zilmax	Control	Zilmax	Control	Zilmax	SEM	Zilmax	Withdrawal	W × Z
Marbling score	457	404	466	445	459	442	11	0.001	0.04	0.14
Standard, %	0	1.6	0	0	0	2.8	0.01	0.08	0.38	0.38
Select, %	31.1	54.1	23.2	28.3	27.8	29.7	0.05	0.03	0.01	0.11
Choice, %	64.0	44.3	75.2	71.8	69.1	67.4	0.05	0.07	0.01	0.20
Upper 2/3 choice, %	38.0	18.4	47.4	43.0	33.0	42.8	0.05	0.33	0.02	0.05
Prime, %	5.0	0.1	1.7	0.18	3.3	0.1	0.02	0.01	0.53	0.53

[1] W × Z, Interaction between withdrawal and Zilmax.

Table 6. Effects of Zilmax, withdrawal time, and postmortem aging on shear-force values of loin steaks

	3-day withdrawal		10-day withdrawal		17-day withdrawal			P-values[1]				
Item	Control	Zilmax	Control	Zilmax	Control	Zilmax	SEM	Z	W	A	Z × A	Z × W × A
Shear force, lb												
7-day aged	7.54	8.40	8.03	9.70	8.20	9.79	0.14	0.001	0.31	0.001	0.054	0.8
14-day aged	6.62	7.30	7.01	8.04	7.01	8.53	0.14	0.001	0.31	0.001	0.054	0.8
21-day aged	8.13	9.55	6.20	7.21	6.28	7.11	0.14	0.001	0.31	0.001	0.054	0.8

[1] Z, Zilmax; W, Withdrawal time; A, Aging.