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Abstract
As the world's population continues to expand, demand for food animal products is also increasing; therefore, efficient production is vital. Implants and beta-adrenergic agonists such as Zilmax (Merck Animal Health, Summit, NJ) improve average daily gain and feed efficiency in feedlot cattle. Use of these growth technologies also increases hot carcass weight and muscle mass. Although use of implants and Zilmax increases efficiency of beef production, these products also negatively affect meat quality characteristics such as marbling and tenderness. Some research reports conclude that wet aging meat for extended periods of time can alleviate tenderness issues caused by exogenous growth promotants. The objective of this experiment was to examine the effects of implants and Zilmax on meat tenderness across five aging periods and to evaluate moisture retention during the cooking process.

Keywords
Cattlemen's Day, 2014; Kansas Agricultural Experiment Station contribution; no. 14-262-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1101; Beef Cattle Research, 2014 is known as Cattlemen's Day, 2014; Beef; Zilmax; Tenderness; Weight gain

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Aging for 35 Days Does Not Improve Tenderness of Strip Loin Steaks From Heifers Fed Zilmax

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Introduction

As the world's population continues to expand, demand for food animal products is also increasing; therefore, efficient production is vital. Implants and beta-adrenergic agonists such as Zilmax (Merck Animal Health, Summit, NJ) improve average daily gain and feed efficiency in feedlot cattle. Use of these growth technologies also increases hot carcass weight and muscle mass. Although use of implants and Zilmax increases efficiency of beef production, these products also negatively affect meat quality characteristics such as marbling and tenderness. Some research reports conclude that wet aging meat for extended periods of time can alleviate tenderness issues caused by exogenous growth promotants. The objective of this experiment was to examine the effects of implants and Zilmax on meat tenderness across five aging periods and to evaluate moisture retention during the cooking process.

Experimental Procedures

Thirty-three crossbred yearling heifers (1,022 ± 5 lb initial body weight) were blocked by body weight and randomly assigned to three treatment groups. Treatments consisted of a control group (no implant, no Zilmax), an implant-only group that was implanted with Component TE-200 (Elanco Animal Health, Greenfield, IN) on day 1 of the study, and an implant + Zilmax group that received Component TE-200 on day 1 of the study and Zilmax 23 days prior to slaughter with a 3-day withdrawal period. After 75 days on feed (Table 1), animals were harvested at a commercial abattoir; slaughter and carcass data were collected. After a 36-hour chill period, strip loins were removed from one side of each carcass and transported to Kansas State University. Five 1-in.-thick steaks were cut from each loin, beginning at the posterior end, and were assigned randomly to wet aging periods of 3, 7, 14, 21, or 35 days at 33°F.

Steaks were cooked and objective tenderness was measured by Warner-Bratzler shear force. Weight of each steak was recorded before and after cooking to calculate moisture loss, which was derived using the equation: [(initial weight-cook weight)/initial weight] × 100. Steaks were cooked on an indoor-outdoor grill (Hamiton Beach, Southern Pines, NC) to an internal temperature of 158°F, then chilled overnight at 33°F. Six cores were removed from each steak, parallel to the muscle fibers, and sheared through the center using an Instron Universal Testing Machine with a Warner-Bratzler shear head. Peak force for each core was recorded, and the average of the six values was used to characterize tenderness of the steak.

Results and Discussion

Numerous studies have demonstrated that the use of beta agonists and implants improve feedlot performance and carcass characteristics. In this experiment, no differences were detected between treatments for dry matter intake, average daily gain,

or final body weight ($P > 0.10$; Table 2). Cattle in the implant and Zilmax/implant treatments had numerically greater average daily gains (17%) and final body weights (2%) than the control animals. Compared with the control group, the combined use of implants and Zilmax increased hot carcass weight, ribeye area, and backfat thickness ($P < 0.05$). The implant-only group was intermediate and tended to increase these measurements compared with the control group ($P < 0.10$), but the measurements did not differ from the implant/Zilmax group ($P > 0.10$). The increase in ribeye area and decrease in subcutaneous fat demonstrates that growth promotants redirect nutrient utilization toward muscle rather than fat. The depot-specific nature of this nutrient partitioning can be seen by tendency of treatments to affect ($P < 0.10$) marbling score and the inability of treatments to affect ($P > 0.10$) kidney, heart, and pelvic fat percentage. Finally, the increase in muscling and decrease in subcutaneous fat catalyzed by the implant and Zilmax/implant treatments resulted in a tendency for the treatments to increase ($P < 0.10$) carcass dressing percentage.

Previous studies have shown that the use of growth promotants can adversely affect meat tenderness. Several research groups recently have concluded that subjecting meat originating from a growth promoting program to extended aging periods can ameliorate negative effects on tenderness. We examined the effects of extended aging on weight loss during cooking and objective measures of tenderness (Table 3) and found no interaction between duration of aging and usages of exogenous growth promotants ($P > 0.10$) for weight loss during cooking. For Warner-Bratzler shear force, there was an interaction ($P < 0.01$) between treatment and day of aging. Wet aging generally improved tenderness of loin steaks, and the magnitude of change was greatest for the Zilmax/implant group. On day 3 postmortem, shear force values for Zilmax/implant steaks were 1.78 and 4.13 pounds greater than the implant and control treatments, respectively ($P < 0.05$). Extended aging to 35 days postmortem appeared to resolve the tenderness issue stimulated by the implant treatment, as indicated by implant and control steaks having similar ($P > 0.10$) shear force values. In contrast to the implant treatment, extending aging did not benefit the Zilmax/implant group as indicated by steaks from this treatment that had shear force values greater than the implant and control steaks ($P < 0.05$).

Implications

Warner-Bratzler shear force of strip loin steaks improves with longer aging times, but adverse effects of exogenous growth promotants are only partially overcome by wet aging.

Table 1. Diet composition, dry matter basis

Ingredient	Percentage of diet
Steam-flaked corn	53.59
Corn gluten feed	35.00
Ground alfalfa hay	4.00
Ground wheat straw	3.00
Vitamin/mineral supplement[1]	2.25
Feed additive premix[2]	2.16

[1]Formulated to provide 0.7% calcium, 0.7% potassium, 0.3% salt, 0.1 ppm cobalt, 10 ppm copper, 60 ppm manganese, 0.3 ppm selenium, 60 ppm zinc, 1000 KIU/lb vitamin A, and 20 IU/lb vitamin E on a dry matter basis.
[2]Formulated to provide 300 mg/day Rumensin and 90 mg/day Tylan per animal in a ground corn carrier.

Table 2. Feedlot performance and carcass characteristics for heifers finished with or without TE-200 implants[1] and/or Zilmax[2]

Item	Control	Implant	Zilmax/ implant	SE	*P*-value
Dry matter intake, lb/day	18.66	17.98	17.83	0.5	0.48
Average daily gain, lb	1.99	2.33	2.33	0.17	0.30
Feed:Gain	9.09	7.69	7.69	0.19	0.06
Final body weight, lb	1170	1194	1194	15	0.31
Hot carcass weight, lb	$762.5^{a,x}$	$781.3^{b,y}$	797.7^{b}	9.1	0.01
Dressing percentage, %	65.2	65.4	66.8	0.51	0.07
Ribeye area, in.^{2}	$12.12^{a,x}$	$13.77^{b,y}$	14.29^{b}	0.57	0.04
Backfat, in.	$0.79^{a,x}$	$0.60^{b,y}$	0.51^{b}	0.07	0.04
Kidney, pelvic, and heart fat, %	2.5	2.4	2.4	0.1	0.54
Marbling score[3]	611	534	561	24	0.10

[a,b] Values within a row are significantly different ($P < 0.05$).
[x,y] Values within a row tend to be different ($P < 0.10$).
[1]TE-200 Component implant, Elanco Animal Health, Greenfield, IN.
[2]Zilmax, Merck Animal Health, Summit, NJ.
[3]Marbling scores were obtained by a USDA grader; slight = 400–499, small = 500–599, modest = 600–699.

Table 3. Warner-Bratzler shear force and weight loss during cooking for strip loin steaks aged 3, 7, 14, 21, or 35 days and cooked to an internal temperature of 158°F

Item	Control	Implant[‡]	Zilmax/implant[3]	SEM
Weight loss[1,2], %				
Day 3	19.9	20.7	20.8	1.05
Day 7	16.7	19.5	17.5	1.05
Day 14	22.0	21.9	23.1	1.05
Day 21	20.3	21.5	19.8	1.05
Day 35	21.9	21.7	21.5	1.05
Warner-Bratzler Shear Force, lb				
Day 3	9.3^{a}	11.6^{b}	13.4^{c}	0.59
Day 7	7.8^{a}	9.8^{b}	11.0^{b}	0.59
Day 14	8.7^{a,x}	10.0^{b,y}	12.0^{c}	0.59
Day 21	8.94^{a,x}	9.5^{a,b}	10.1^{b,y}	0.59
Day 35	8.7^{a}	9.4^{a}	10.6^{b}	0.59

^{a,b,c} Means in a row with a common superscript are the same ($P < 0.01$).
^{x,y} Means in a row with different superscripts are different ($P < 0.10$).
[1] [(initial weight-final weight)/ initial weight] ×100.
[2] No day of aging × growth promotant interaction ($P > 0.10$).
[3] TE-200 Component implant, Elanco Animal Health, Greenfield, IN; Zilmax, Merck Animal Health, Summit, NJ.