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Evaluation of Growth Performance, Energy Utilization, and Carcass Trait Responses of Finishing Lambs Administered Zeranol

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Abstract

The objective of this research was to determine the influence of implanting heavy wether lambs with 12 mg zeranol (1 pellet Ralgro, Merck Animal Health. Madison, NJ) 59 d before harvest. Average daily gain (ADG), feed efficiency, and carcass merit were evaluated. Polpypay and crossbred wethers (n = 32 total) were equally divided into two treatment groups within a randomized complete block design. Sixteen pens were used resulting in 8 replicate pens per treatment. Wethers were fed a finishing diet consisting of cracked corn, soybean meal and soybean hulls *ad libitum* for 59 d. Lambs had access to clean water at all times from water fountains. Lambs were weighed on d 0, 1, 14, and 59 lambs. On d 59, 16 lambs (8 lambs/treatment) were harvested in the South Dakota State University Meat Lab. Hot carcass weight (HCW), dressing percent (DP), rib fat, body wall thickness, ribeye area, boneless closely trimmed retail cut percentages and yield grades were recorded. Final body weight (BW), cumulative ADG and gain efficiency were greater ($P \leq 0.01$) for implanted lambs by 2.9%, 25.0%, and 35.2%, while dry matter intake (DMI) was not appreciably influenced by implant treatment ($P = 0.18$). No appreciable differences were noted ($P \geq 0.17$) between treatments for any carcass traits measured. These results indicate that zeranol improves growth performance without detriment to carcass quality which implies that producers can improve profitability due to increased gains and efficiency.

Keywords: anabolic, growth, sheep

Introduction

The use of the growth promoting anabolic implant zeranol was approved for use in cattle and sheep in 1969 by the Food and Drug Administration. Zeranol originates from the mycotoxin zearalenone, which is a product of a *Fusarium* fungus. The anabolic agent has weak estrogenic activity which improves performance by stimulating the pituitary gland, resulting in the synthesis of growth hormone. Increases in growth hormone secretion can result in extended bone growth and consequently increase lean muscle growth. Zeranol implants have been shown to improve performance of sheep, as evidenced through increased ADG and feed efficiency (Wilson et al., 1972; Sluiter et al., 2007; Jones et al.,1997; and Stultz, 2000). However, the use of zeranol in sheep feedlot settings is much more limited than the extensive use seen in cattle production.

Zeranol effects on carcass data have been inconsistent in previous studies. Eckerman et al., 2013 reported no appreciable difference in HCW, fat depth, body wall thickness, ribeye area, flank streaking, quality grade, yield grade, boneless closely trimmed retail cuts, or DP. Likewise, Sluiter et al., 2007 found that 12 mg zeranol had a positive impact on performance but did not affect carcass characteristics. In contrast, Stultz 2000 observed a statistical difference in ribeye area and hot carcass weight whereby the implanted lambs possessed a larger ribeye and HCW. While the effects of zeranol on performance are well documented, effects on carcass characteristics are less understood. Ideally, carcasses should be heavy, have minimal fat deposition, large ribeyes and a high percentage of boneless closely trimmed retail cuts. The objective of this study was to further investigate the impacts of 12 mg zeranol on growth performance, feed efficiency, and carcass merit of heavy wether lambs.

Two common commercial sheep breeds were used for this investigation. Purebred Polypay sheep made up the majority of the experimental design. Hampshire x Polpypay crossbreds were also used as a result of minimal access to sheep of similar age, weight, and breed.

Materials and Methods

Institutional Animal Care and Use Approval

This study was conducted at the South Dakota State University Sheep Unit Research Feedlot (SU) in Brookings, SD between September and November of 2022. The animal care and handling procedures used in this study were approved by the South Dakota State University Animal Care and Use Committee (2208-045).

Wether Management and Treatments

Polypay (blocks 1 to 7) and Hampshire × Polypay (block 8) crossbred wethers (initial BW = 61.9 ± 6.6 kg) were used in a 59-d finishing study. Wethers were procured from South Dakota State University Sheep Unit. Initial processing was conducted approximately 60 d before the initiation of the present experiment and included vaccination against enterotoxemia and treatment for internal and external parasites. All wethers had a unique identification tag and were weighed individually (scale readability 0.454 kg) on d 1, 14, and 59.

Wethers were assigned to 1 of 16 uncovered pens (3.1 m × 3.1 m earthen surface pens with 3 a 1.0 m covered poly-feeder; 8 pens/treatment; 2 wethers per pen) in a randomized complete block design (blocked by initial BW) and pen was randomly assigned to 1 of 2 treatments: a control group receiving no steroidal implant (CON) or a group administered 12 mg of zeranol (Merck Animal Health, Madison, NJ) subcutaneously in the middle third of the ear 59 d before harvest (IMP).

Dietary Management

If carryover feed was present on weigh days, the residual feed was removed prior to the collection of BW measurements. Carryover feed and feed that was spoiled (e.g., rained on) was collected, weighed, and dried in a forced air oven at 100°C for 24 h to determine DM content.

The dry matter intake (DMI) of each pen was adjusted to reflect the total DM delivered to each pen after subtracting the quantity of dry orts for each interim period. Actual diet formulation and composition (Table 1) was based upon monthly DM analyses (drying at 60°C until no weight change), tabular nutrient values (Preston, 2016), and feed batching records.

Growth Performance Calculations

Wethers were individually weighed at prior study initiation (d -1) to normalize pen allotments. Wethers were also individually weight on d 1, d 14 and 59 (final day of experiment). Cumulative daily weight gain was based upon initial (d -1 and 1 body weight average) shrunk body weight (SBW; 4% shrink) and final shrunk BW (4% shrink). Shrunk body weight accounts for feed and water intake. Average daily gain (ADG) was calculated by subtracting the final shrunk BW from the initial shrunk BW and dividing by days on feed. Gain to feed ratio (G:F) was calculated by dividing ADG by DMI.

Dietary NE utilization Calculations

Observed dietary net energy (NE) was calculated from daily energy gain (EG; Mcal/d) according to $0.254 \times \text{ADG} \times \text{SBW}^{0.75}$ assuming a mature weight of 125 kg for Polypay (NASEM, 1985). Maintenance energy required (EM; Mcal/d) was calculated by the following equation: EM, Mcal/d = $0.056\text{SBW}^{0.75}$ where SBW was the average of initial shrunk BW and final shrunk BW (NASEM, 1985). Using the estimates required for maintenance and gain, the observed dietary net energy for maintenance (NE_m) and net energy for gain (NE_g) values of the diet were generated using the quadratic formula:

$$x=-b\pm b2-4ac−−−−−−−\surd 2c$$

where x = NE_m, Mcal/kg, a = -0.41EM, b = 0.877EM + 0.41DMI + EG, c = -0.877DMI, and NE_g was determined from: 0.877 NE_m – 0.41 (Zinn and Shen, 1998; Zinn et al., 2008). The ratio of observed-to-expected NE ratio was determined from observed dietary NE for maintenance or gain divided by tabular NE for maintenance or gain. This ratio was used to evaluate the amount of energy that went towards maintenance needs, and the amount of energy that resulted in weight gain. A number greater than 1 indicates a greater amount of utilized energy than expected.

Expected DMI, the following equation was used: DMI (kg) = FFM + FFG. Feed for maintenance (FFM; kg) was the EM divided by the tabular NE_m value. Feed for gain (FFG; kg) was the EG divided by the tabular NE_g value. The ratio of observed-to-expected DMI was determined from observed DMI divided expected DMI. For this calculation a lower number is more desirable as it indicates less feed intake for equal weight gain.

Harvest and Carcass Data Collection

Sixteen wethers were harvested at the South Dakota State University Meat Lab on day 59. One wether was randomly selected from each pen allotment; thus, carcass data was collected from eight CON and eight IMP wethers. Once harvested, HCW and DP was recorded for each, and lambs were hung in a 35°F cooler for 5 days. On day 64, carcasses were measured and evaluated for rib fat thickness, body wall depth, ribeye area, and USDA quality grades. Percent boneless closely trimmed retail cuts were also calculated at this time.

Statistical Analysis

Data was analyzed using analysis of variance appropriate for a randomized complete block design experiment using the GLIMMIX procedures of SAS 9.4 (SAS Inst. Inc. Cary, NC). Implant treatment was included as a fixed effect, and block was considered a random factor; pen served as the experimental unit for all analyses. Least squares means were generated using the LSMEANS statement and treatment effects were analyzed using the pairwise comparisons

PDIFF and LINES option. An α of 0.05 determined significance and an α of 0.06 to 0.10 was considered a tendency.

Results & Discussion

Growth performance and carcass data are located in Table 2. Initial BW was similar between treatments ($P = 0.14$). Final BW, cumulative ADG and gain efficiency were greater ($P \leq 0.01$) for IMP by 2.9%, 25.0%, and 35.2%, while DMI was not appreciably influenced by implant treatment ($P = 0.18$). The observed dietary NE_m value was increased by 18.5% and NE_g by 24.7% for IMP compared to CON ($P \leq 0.01$). The ratio of observed-to-expected NE_m and NE_g were greater for IMP as compared to CON ($P \leq 0.01$), meaning that a greater amount of consumed energy was put towards maintenance and weight gain. The ratio of observed-to-expected DMI was less for IMP compared to CON ($P \leq 0.01$). These ratios together indicate more efficient utilization of nutrients. Application of 12 mg of zeranol did not appreciably ($P \leq 0.17$) influence any carcass traits measured.

Based on past findings, 12mg zeranol positively impacted lamb performance by increasing ADG; our results concur as shown in Table 2. Sluiter et al. (2007), Jones et al. (1997), and Stultz (2000) all reported increased ADG. Sluiter et al. (2007) looked at the effects of three different implants in growing lambs. Seventy-five lambs were implanted with zeranol (Ralgro) and then compared against a control group and two other implant treatments (Synovex and Component C^3). Sluiter et al. reported that lambs with zeranol had a higher ADG than the control lambs, but that the lambs implanted with zeranol did not gain as quickly as those implanted with the Synovex and Component C^3. Stultz (2000) used 146 lambs in a similar trial with a control group and a zeranol implanted group. Weights were recorded on days 0, 28, 56, 84 and 105, then average daily gains computed for each of the time increments. Stultz reported a statistical increase in ADG between days 0-28, 29-56, 57-84; however there was not a significant difference between the groups from day 85-105. The final body weights of the implanted lambs were still heavier. In 1997, Jones et al. had 64 feeder lambs split by a two by four factorial in order to evaluate the use of zeranol and *Saccharomyces cerevisae* yeast culture. Differences due to zeranol were singled out and resulted in an improved ADG of 19% over the course of the entire feeding period, with the most notable time frame being between days 56 and 69 where a 32% increase in ADG was recorded. Our observed 25% increase in ADG aligns with these previous findings.

Jones et al. (1997) recorded a 14.4% improved feed efficiency of implanted lambs. This is comparable to our 26% observed increase of DMI/ ADG. This is critical to the profitability of growing lambs as it results in decreased feed costs for equal amounts of gain.

The greater utilization of energy as shown by the higher observed to expected NE ratios for implanted wethers is a reflection of the non-nutritional action of implants. These actions affect composition of gain by enhancing net protein retention, and result in leaner-than-expected tissue growth for the specified live weight and rate of gain (NASEM, 1985). Additionally, the lower, more desirable observed to expected DMI ratio is also a reflection of more efficient use of energy by IMP wethers.

Past results of the effect of zeranol on carcass traits have been inconsistent. We observed no significant differences between CON and IMP wethers. However, as shown in Table 2, numerical averages of IMP wethers show a slightly higher hot carcass weight, percentage of boneless closely trimmed retail cuts, ribeye area, less rib fat, and a lower yield grade. In contrast, the control lambs had a numerically higher average dressing percent. This aligns with previous studies of Jones et al. (1997) and Stultz (2000) who found no appreciable differences in carcass characteristics between implanted and control lambs. In contrast Larson S. (1983) found a slight increase in ribeye area and less body fat in the implanted vs. control lambs.

Conclusion

Implanting heavy weight finishing lambs with 12 mg of zeranol increased daily gain and enhanced the efficiency of energy capture from the diet without detriment to carcass quality. This is critical as the use of zeranol can aid in increasing the pounds of meat produced without altering the number of sheep or amount of feed required. Such implications provide promise for the United States to become more sustainable in terms of lamb production, as the United States currently does not harvest enough lamb to meet its demands.

Conflict of interest

The author declares no conflict of interest.

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Table 1. Finishing diet formulation, nutrient composition, and energy values[1]

Item	**Finishing diet**
Cracked Corn, %	59.46
Pelleted Supplement, %	22.80
Soybean Hulls, %	15.20
Soybean Meal, %	2.54
Dry matter (DM), %	88.89
Crude protein, %	15.14
Net energy for maintenance, Mcal/kg	1.83
Net energy for gain, Mcal/kg	1.23

[1] All values except for Dry Matter are on a Dry Matter basis.

Table 2. Cumulative growth performance and carcass trait responses following 59 d of implantation.[1]

Item	**Treatment[2]** **CON**	 **IMP**	**SEM**	***P* - value**
No. Wethers (carcasses)	16 (8)	15 (8)	-	-
No. Pens (carcass data)	8 (8)	8 (8)	-	-
Initial body weight (BW), kg	61.82	61.32	0.305	0.14
Cumulative live growth				
Final BW, kg	72.62	74.75	0.612	0.01
Average daily gain (ADG), kg	0.181	0.227	0.0113	0.01
Dry matter intake (DMI), kg	1.74	1.62	0.085	0.18
ADG/DMI	0.105	0.142	0.0096	0.01
DMI/ADG	9.52	7.04	0.0096	0.01
Observed diet net energy (NE), Mcal/cwt				
Maintenance	1.85	2.20	0.087	0.01
Gain	1.22	1.52	0.076	0.01
Observed to expected				
Maintenance (NE_m)	1.01	1.20	0.047	0.01
Gain (NE_g)	0.98	1.23	0.062	0.01

DMI	1.02	0.83	0.050	0.01
Carcass traits				
Hot carcass weight (HCW), kg	43.82	43.91	0.953	0.95
Dressing percentage, %	60.50	58.70	1.179	0.17
Ribfat, cm	1.37	1.14	0.032	0.27
Body wall, cm	4.14	4.16	0.017	0.78
Ribeye area, cm^2	17.03	17.16	0.023	0.87
Boneless, closely trimmed retail cuts, %	40.11	40.52	0.676	0.55
Yield grade	5.9	4.9	0.81	0.27

[1] A 4% pencil shrink was applied to all BW measures to account for digestive tract fill.

[2] Treatments included: a control group receiving no steroidal implant (CON) or a group administered 12 mg of zeranol (Merck Animal Health, Madison, NJ) subcutaneously in the middle third of the ear 59 d before harvest (IMP).