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Growth and Slaughter Characteristics of Ram and Wether Lambs Implanted with Zeranol

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ABSTRACT: Forty-nine Columbia ram and wether lambs born in April 1990 and 46 born in April 1991 were studied to determine the effects of zeranol implants on growth, difficulty of pelt removal, and carcass characteristics. Implanting ram and wether lambs once (1990) or twice (1991) with 12 mg of zeranol did not change live weight or ADG but gain/feed decreased ($P < .05$) in ram lambs slaughtered at approximately 50 kg. Testes weight was reduced approximately 50% by implanting. Two implants reduced ($P < .05$) the force needed to pull the pelt from the hind legs of ram lambs, but implanting tended to increase the force required to pull the pelt from wether lambs. Data for pelt weight, force required to pull the pelt, percentage of the carcass in the shoulder or splenius muscle, and Warner-Bratzler shear values showed that zeranol implants resulted in ram lambs becoming more like wethers and wether lambs becoming more like rams. Implanting with zeranol did not affect closure of the metacarpal growth plate in ram or in wether lambs. Difficulty of pelt removal can be reduced by implanting ram lambs with 12 mg of zeranol at approximately 114 d of age and reimplanting zeranol 28 d later.

Key Words: Sheep, Zeranol, Pelts, Rams, Composition

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Introduction

More force is required to remove pelts from ram lambs than from wether lambs (Andersen et al., 1991b). In addition, the amount of force required to remove ram pelts increases with age and masculine development (Andersen et al., 1991a). Greater force required to remove pelts from rams results in increased labor, increased equipment maintenance, and reduced slaughter speed (Seideman et al., 1982). These factors contribute to price discounts for ram lambs and discourage producers from taking advantage of a ram lamb's superior growth rate, feed efficiency, and carcass leanness (Field, 1971).

Studies of zeranol implantation in lambs have focused on growth rate, feed efficiency, and carcass characteristics (Wilson et al., 1972; Larson et al., 1983; Rompala et al., 1988; Hufstedler et al., 1990; Hutcheson et al., 1992), but little information is available on the effect of zeranol on masculine characteristics in ram lambs. The implantation of zeranol in bulls shortly after birth has been shown to reduce masculinity and management problems (Greathouse et al., 1983; Gray et al., 1986; Unruh et al., 1986). Because implantation of zeranol reduces masculine development and management problems in bulls, we postulated that this estrogen-like substance might have a similar effect on young rams. If a reduction in force required to remove the pelt during processing accompanies the reduction in masculinity, a major objection to ram lamb production could be overcome.

The objective of this research was to determine the effects of implanting ram lambs on growth, difficulty of pelt removal, and carcass characteristics. Wether lambs also were implanted or left as controls, for comparative purposes.

Materials and Methods

Forty-nine Columbia ram lambs born in April 1990 and weighing approximately 35 kg were used that year and 46 ram lambs born in April 1991 were used in that year. Each year the lambs grazed on range with their dams until weaning at approximately 100 d. Each year one-half of the ram lambs were castrated at weaning. In 1990 one-half of the intact rams and one-half of the wethers were implanted with 12 mg of zeranol 2 wk after weaning. Lambs were started on a 20% corn/alfalfa pellet and adjusted to an 85%

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pelleted corn diet during a 28-d period. All lambs in 1990 were group-fed the 85% pelleted corn diet on an ad libitum basis for 56 d. In 1991, three or four lambs per treatment were fed in the same pen and each lamb in the groups implanted with zeranol was given an additional 12 mg of zeranol 28 d after the first implant. Three replications within ram vs wether and treatment were used. Total time on feed for the lambs in 1991 was 70 d, including the 28-d adjustment period. Average daily gain and feed efficiency were calculated within each implant period in 1991.

Lambs were trucked from Dubois, ID to the University of Wyoming. The following day they were electrically stunned, hoisted, and bled. They were prepared for pelt removal by cutting down the back of the legs, cutting around the bung, and splitting the skin on the tail to reduce the force required to remove the pelt and to reduce grain crack in the pelts. Lambs were suspended from the front legs by a gambrel as described by Andersen et al. (1991 a,b). The gambrel was attached to a scale that recorded the amount of force (in kilograms) required for a belt type R2 Minipelter (Koch Supplies, Kansas City, MO) to pull the pelts from the hind legs. Dry pelts were weighed immediately after removal. In 1990 the lambs were shorn 52 d before slaughter, but in 1991 lambs were not shorn. Both testes were removed and weighed with the epididymis and tunica albuginea attached. The epididymis was cut from the vas deferens where the two join together. Weight of both testicles was recorded immediately after removal.

Carcasses were transferred to trolleys and suspended by their hind legs after the pelts were removed. Leg damage (the amount of fell and fat removed from the leg) was scored on a 5-point scale, where 1 = no fell or fat removed from the leg and 5 = almost all fell and fat removed. Standard quality and yield grade measurements (USDA, 1982) were recorded 24 h postmortem. Kidney and pelvic fat was removed and weighed to determine the percentage of hot carcass weight.

The crosscut shoulder consisting of the neck, shoulder, breast, and shank was removed between the 5th and 6th ribs, weighed, and expressed as a percentage of the hot carcass weight in 1990. In 1991, the crosscut shoulder was weighed after removing the breast and shank. One splenius muscle, a muscle from the neck that increases with masculine development (Butterfield et al., 1984), was dissected and weighed to measure the extent of masculine development. A 4-cm-thick chop was removed from the 12th rib region of the longissimus after 7 d of aging at 2 to 4°C and frozen at −40°C. Chops were thawed at 2 to 4°C and roasted in a convection oven at 177°C to an internal temperature of 74°C. Cooked chops were then cooled, wrapped in freezer paper, and held overnight in a 2 to 4°C cooler before Warner-Bratzler shear force values were determined. Two cores (1.27 cm o.d.) were cut parallel to the muscle fibers and each core was sheared four times. The average of eight shears was determined.

Data were analyzed within year as a function of ram vs wether and implant treatments using the GLM procedure of SAS (1985). A within-year analysis was used because of differences between years in number of implants, feeding methods, and data obtained. Means for main effect interactions were reported because in most instances interactions for the main effects were significant ($P < .05$) or they approached significance. Differences in means were determined by linear contrasts when a significant F-value was observed.

Results and Discussion

Characteristics of ram and wether lambs implanted once with 12 mg of zeranol in 1990 (Table 1) are discussed separately from characteristics of rams and wethers implanted twice in 1991 (Table 2). Rams were heavier than wethers at slaughter ($P < .05$), but lambs implanted with zeranol were not heavier ($P > .05$) than control lambs within gender groups (Table 1). Although zeranol did not significantly improve ADG, other studies (Wilson et al., 1972; Larson et al., 1983; Nold, 1990; Hutcheson et al., 1992) have reported advantages in ADG when lambs implanted with zeranol were compared with controls.

Weight of the testes was reduced approximately 50% by implanting 114-d-old, 35-kg ram lambs with 12 mg of zeranol at the beginning of the feeding period. Nold (1990) reported that implanting ram lambs at birth and again at weaning (24 kg) reduced testicle weight by 25% compared with controls. Nold's lambs were slaughtered at 139 to 155 d of age. Testicles were removed, vacuum-packaged, and frozen and were later dissected free of other tissues including epididymis before weighing. These lambs were slaughtered at three time-constant end points: 78, 93, or 107 d after the last implanting. Unruh et al. (1986) reported that reductions in weight of testicles from bulls implanted at birth and reimplanted at average intervals of 84 d until slaughter varied by slaughter age of animals. At 12 and 13.8 mo of age testicle weight was reduced more than half by implanting, but by 15.7 mo of age testicles from bulls implanted with zeranol were only 25% smaller than those from control bulls. Differences in the percentage of reduction of ram testicle weights when the study of Nold (1990) and the current study are compared may be related to time of implanting and age at slaughter. Although ram lambs in both studies weighed approximately 50 kg at slaughter, those in the study of Nold (1990) averaged 139 to 155 d of age, compared with approximately 180 d of age in the current study. Time from last implanting to slaughter was 53 d in 1990 and 45 d in 1991 in the current study and 78, 93, or 107 d after the last implanting in the study of Nold

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Table 1. Characteristics of ram and wether lambs implanted once with 12 mg of zeranol

	Rams		Wethers		
Item	Zeranol	Control	Zeranol	Control	SE
n	13	11	13	12	—
Initial wt, kg	36.86[a]	36.82[a]	36.86[a]	36.82[a]	.14
Final wt, kg	51.47[c]	50.72[bc]	47.98[ab]	45.74[a]	1.16
ADG, kg[d]	.26[a]	.25[a]	.20[b]	.16[b]	.02
Hot wt, kg	27.04[b]	27.07[b]	26.24[ab]	24.91[a]	.72
Testes wt, g	263.61[a]	508.54[b]	—	—	25.03
Pelt wt, kg	4.44[b]	4.30[b]	4.05[ab]	3.69[a]	.15
Pelt force, kg	181.96[b]	190.72[b]	162.25[a]	149.31[a]	4.87
Kidney fat, %	2.06[a]	2.02[a]	1.99[a]	2.09[a]	.14
Fat depth, cm	.36[a]	.36[a]	.54[b]	.42[a]	.04
Flank streaking[e]	3.58[a]	3.61[a]	3.66[a]	3.59[a]	.13
Shoulder, %[f]	34.55[b]	34.79[b]	33.65[a]	33.68[a]	.36
Splenius, %[g]	.060[b]	.062[b]	.044[a]	.045[a]	.003
Leg damage[h]	1.77[a]	1.54[a]	1.77[a]	1.00[a]	.31
Warner-Bratzler shear force, kg	2.01[a]	2.45[b]	—	—	.08

[a,b,c]Means on the same line that do not have a common superscript differ ($P < .05$).
[d]Based on weight at feedlot, and final weight is shrunk weight at abbatoir. Days on feed = 56.
[e]2.3 = Traces[30], 3.4 = Small[40].
[f]Untrimmed neck, shoulder, foreshank, and brisket weight divided by hot carcass weight × 100.
[g]One splenius muscle weight divided by hot carcass weight × 100.
[h]Rated on a 5-point scale, where 1 = no fell or fat removed from the leg and 5 = almost all fell and fat on the legs damaged or removed.

Table 2. Characteristics of ram and wether lambs implanted with 12 mg of zeranol and reimplanted 28 days later

	Rams		Wethers		
Item	Zeranol	Control	Zeranol	Control	SE
n	11	12	11	12	—
Initial wt, kg	35.69[a]	35.89[a]	33.60[b]	33.96[b]	.71
Final wt, kg[d]	48.45[ab]	51.75[b]	46.96[a]	46.45[a]	1.21
ADG, kg[e]					
1–28 d on feed	.24[a]	.28[a]	.28[a]	.22[a]	.02
29–70 d on feed	.25[a]	.31[b]	.27[ab]	.24[a]	.01
Gain (g)/feed (kg)					
1–28 d on feed	137[a]	139[a]	141[a]	139[a]	45
29–70 d on feed	131[a]	158[b]	138[ab]	125[a]	45
Hot wt, kg	24.16[ab]	25.76[b]	24.14[ab]	23.59[a]	.64
Testes wt, g	202.90[a]	422.67[b]	—	—	23.34
Pelt wt, kg	5.42	6.01[b]	5.42[ab]	4.97[a]	.24
Pelt force, kg	145.35[b]	161.59[c]	139.17[ab]	128.52[a]	3.52
Kidney fat, %	2.56[a]	2.57[a]	2.62[ab]	3.04[b]	.15
Fat depth, cm	.35[a]	.30[a]	.56[b]	.49[b]	.05
Flank streaking[f]	2.89[ab]	2.62[a]	3.44[b]	3.17[ab]	.26
Shoulder, %[g]	27.55[ab]	29.45[b]	27.34[ab]	25.72[a]	.91
Splenius, %[h]	.056[b]	.066[c]	.046[a]	.040[a]	.003
Leg damage[i]	1.73[a]	1.50[a]	1.91[a]	1.33[a]	.28
Warner-Bratzler shear force, kg	1.92[ab]	2.18[b]	2.07[ab]	1.85[a]	.09

[a,b,c]Means on the same line that do not have a common superscript differ ($P < .05$).
[d]Shrunk weight at abbatoir in Wyoming.
[e]Based on weight at feedlot in Idaho.
[f]2.3 = Traces[30], 3.4 = Small[40].
[g]Untrimmed neck and shoulder divided by hot carcass weight × 100.
[h]One splenius muscle divided by hot carcass weight × 100.
[i]Rated on a 5-point scale, where 1 = no fell or fat removed from the leg and 5 = almost all fell and fat on the legs damaged or removed.

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(1990). Therefore, the predicted circulating estrogenic activity from zeranol would be higher in our lambs, and this could help explain differences in weight reduction of the testes between the two studies. Year and season (Field et al., 1989) might also have contributed differences in testicle weight. In the current study testicle weights were heavier in 1990 than in 1991; the reason for this difference was not apparent. Reduction in testicle weight of implanted rams (Table 1) was not accompanied by a reduction in force required to remove the pelt ($P < .05$). However, the trend was for zeranol to decrease the force needed to remove the pelt in rams and increase it in wethers. Differences in force required to remove the pelts from rams compared with wethers was significant, confirming earlier work of Andersen et al. (1991b).

Neither kidney fat percentage nor fat depth over the longissimus muscle at the 12th rib was influenced by implanting rams with zeranol (Table 1). Degree of flank streaking, a major factor influencing quality grade of lambs (USDA, 1982), also was not altered by implanting. The greater amount of fat depth over the longissimus muscle of implanted than of control wethers ($P < .05$; Table 1) is not supported by other studies. No difference in fat depth between implanted and control ram, ewe, and(or) wether lambs was reported by Wilson et al. (1972), Larson et al., (1983), and Rampala et al. (1988).

Percentages of shoulder and splenius muscle were recorded because these measures of masculine development (Field et al., 1989) could be affected by zeranol implants. Although differences between rams and wethers were evident, one zeranol implant at weaning did not affect percentage of shoulder or splenius muscle within gender groups (Table 1).

Warner-Bratzler shear force values were reduced by implanting ram lambs with zeranol. This finding confirms the work of Nold (1990), who found that sensory scores for myofibrillar tenderness, connective tissue tenderness, and overall tenderness were improved when ram lambs were implanted with zeranol. Unruh et al. (1986) reported that implanting bulls resulted in less collagen accretion and a delay in collagen maturation, which was probably related to a reduction in testosterone production (Gray et al., 1986).

Reimplanting ram lambs 28 d after the first implant decreased ($P < .05$) ADG during the period between 29 and 70 d, and ram lambs implanted with zeranol required more feed per unit of gain ($P < .05$) than control rams (Table 2). Feed efficiency of implanted rams was similar to that of implanted and control wethers. The trend for reduced force to pull the pelt from ram lambs that was apparent with one zeranol implant (Table 1) became significant ($P < .05$) when rams were implanted at weaning and again 28 d later (Table 2). The difference was noticeable when fisting over the shoulders and down the sides before mechanical removal of pelts from the legs. Reduced force to remove the pelt in implanted ram lambs should help make ram lambs more acceptable to packers.

Control wethers tended to require less force to remove the pelt than did implanted wethers (Tables 1 and 2). This trend may be related to the tendency for implanted wethers to develop heavier pelts than controls (Table 1 and 2). Data for feed efficiency, pelt weight, and force required to remove the pelt showed that zeranol implants resulted in ram lambs becoming more like wethers and wether lambs becoming more like rams. This observation also is true for percentage of the carcass found in the shoulder and splenius muscle. These measures of masculinity were reduced in implanted ram lambs but they were increased in implanted wether lambs (Table 2). The reasons why reimplanted wether lambs possessed heavier pelts, required greater force to remove the pelt, and possessed heavier shoulders and splenius muscles when implanted twice were not clear. However, Miller et al. (1990) reported that administration of estradiol-17β to wethers tended to raise concentrations of intramuscular collagen so that values were no longer lower ($P < .05$) than those in rams. Our data indicate that pelts, high in collagen, may be stimulated by estrogen-like zeranol implants in wethers and minimized in rams. Heavier shoulders and splenius muscles in wethers implanted twice may also be related to the stimulation of growth. Warner-Bratzler shear force values were reduced in rams and increased in wethers when lambs were implanted (Table 2).

Field et al. (1989) had shown that estradiol implants resulted in earlier growth plate closure in wether lambs and Hufstedler et al. (1990) reported that three or five zeranol implants administered at 30-d intervals resulted in an incidence of 40 or 100% spool joint formation, respectively. We were prepared to study closure of the metacarpal growth plate; however, all ram and wether lambs in our study possessed break joints and no differences in break joint maturity were observed. Hutcheson et al. (1992) reported that 2 of 36 wether lambs implanted once with 12 mg of zeranol possessed spool joints at slaughter. In addition to differences in the number of implants between the present study and that of Hufstedler et al. (1990) and Hutcheson et al. (1992), differences in age and breed of lambs in the two studies might also have been involved in growth plate closure. For example, Ho et al. (1989) reported that at 459 d of age Finn-cross ewe and ram lambs had more ossified epiphyseal plates and more spool joints than did Suffolk-cross lambs.

Implications

Masculinity and difficulty of pelt removal in ram lambs can be reduced by implanting with 12 mg of zeranol at approximately 35 kg and reimplanting 28 d

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later. This procedure tended to reduce difficulty of pelt removal in 180-d-old ram lambs and could result in rams becoming more acceptable to packers.

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