WOOL QUALITY AND YIELD IN FINE-WOOL EWE LAMBS AFTER SHORT-TERM ADMINISTRATION OF OVINE GROWTH HORMONE[1]

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Summary

Thirty fine-wool ewe lambs (six months of age) were randomly allotted to one of three groups before a regular fall breeding season in October. Treatment consisted of either 0, 2.5 or 5 mg ovine growth hormone (oGH) administered (subcutaneously) daily for ten days, then on alternate days for an additional twenty days. Jugular blood samples were collected daily during oGH administration and every third day during the breeding season to determine serum growth hormone (GH) concentrations. Ewe lambs were shorn immediately before treatment began. Body weights and staple length measurements were obtained at monthly intervals. Lambs were shorn four months after treatments were terminated (five-month clip) and five randomly selected fleeces from each treatment group were examined for quality characteristics. One year after the five-month clip, ewes were shorn and grease fleece weights were recorded. Animal weights did not differ ($P > .50$) before (average 100.3 pounds) or after the 30-day injection period (106.0, 104.2 and 108.6 pounds for ewes receiving 0, 2.5 and 5 mg oGH, respectively). During the thirty days of treatment, serum GH was greatly elevated in ewes receiving either dosage of exogenous GH compared with values observed in control ewes. Likewise, serum GH continued to be elevated ($P < .05$) in GH-treated ewes until the end of the thirty-four-day breeding period. Staple length measurements obtained at monthly intervals were, in general, similar among groups. Five-month grease fleece weight in control ewes (6.6 pounds) did not differ ($P > .10$) from that produced by females receiving 2.5 (6.8 pounds) or 5 (6.6 pounds) mg oGH. Similarly, neither clean fleece weight, percentage vegetable matter, fiber diameter nor fleece uniformity differed ($P > .10$) among groups. When grease and clean fleece weights were expressed as a percentage of body weight, no advantages in wool production resulting from oGH were noted. Grease fleece weight obtained 12 months after the five-month clip did not differ ($P > .10$) among treatments. These results indicate short-term administration (thirty days) of 2.5 or 5 mg oGH five months before shearing does not appear to adversely influence wool production.

(Key words: Wool, fleece, sheep, growth hormone)

Introduction

Developments in recombinant DNA technology (Charlton and Cox, 1983) have allowed production of mammalian polypeptides by certain microorganisms. Such technology offers the potential of producing large quantities of biologically active compounds that previously were available only in limited amounts. One mammalian protein of interest to today's agricultural industry is growth hormone (GH), which is produced by the pituitary gland and is involved in overall body growth, milk production and metabolism. Growth hormone administered to ruminants has resulted in increased milk production (Peel et al., 1982, 1983; Eppard el al., 1985) and enhanced carcass growth (Davis et al., 1970; Muir et al., 1983; Johnsson et al., 1985). This material promises to be a means of substantially improving productive efficiency of livestock.

Studies at New Mexico State University are examining ef-

[1]Journal Article 1356 of the New Mexico Agr. Exp. Sta. The authors gratefully acknowledge contributions by B. Hinrichs, C. Roberts and D. Schickedanz. Appreciation is expressed to the National Hormone and Pituitary Program for supplying the ovine growth hormone (NIADDK-oGH-13; AFP-4586) used in this study.

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fects of GH on growth and reproductive characteristics of fine-wool ewes. If benefits to these productive areas are realized, however, wool production must not be compromised. Therefore, an allied project was initiated to evaluate effects of exogenous ovine growth hormone (oGH) on wool production in fine-wool ewe lambs.

Materials and Methods

One month before a fall (October) breeding season, thirty virgin, fine-wool ewe lambs (six months of age) of Rambouillet x Debouillet breeding were randomly allotted to one of three treatment groups. Treatment consisted of either 0 (solubilization vehicle), 2.5 or 5 mg oGH (NIADDK-oGH-13, AFP-4586) administered (subcutaneous) daily for ten days, and continued on alternate days for an additional twenty days. Treatments were administered on alternate days because previous workers (Holcombe et al., 1986) reported serum GH remained elevated several days after a ten-day treatment period in mature ewes. Ovine GH (biopotency = 1.5 IU/mg) was solubilized in sterile saline (.9%) and adjusted to pH10.5 by addition of .025 molar sodium bicarbonate and .025 molar sodium carbonate (Peel et al., 1983), with final volumes (12 ml) containing either 0, 2.5 or 5 mg oGH.

Ewe lambs were maintained at New Mexico State University's West Sheep Unit and were allowed ad libitum access to a pelleted alfalfa diet throughout treatment and the breeding period. After breeding, ewes were offered the diet at 4 pounds/head/day during the first fourteen weeks of gestation and 5.1 pounds/head/day during the last six weeks of gestation. Average diet composition (dry matter basis) consisted of 90% dry matter, 17.5% crude protein, 3.7% ether extract and 31% acid detergent fiber. Facilities were arranged such that animals had continuous access to shade, water, salt and mineral blocks. Weights were obtained before and at monthly intervals for five months after treatment began. Jugular blood samples were collected from all ewes daily during the injection period and every third day during the breeding season to establish serum GH levels. Serum GH was quantified using a radioimmunoassay technique described by Hoefler and Hallford (1987). At the end of treatment, ewe lambs were allowed to mate with Debouillet rams during a thirty-four-day breeding period.

Ewe lambs were shorn immediately before initiation of treatment and staple length measurements obtained from three locations were recorded monthly: point of shoulder (S, over the scapulo-humeral joint), mid-section (M, lateral surface over the last rib) and hip (H, over the tuber coxae). Ewes were shorn a second time five months after the first shearing. In addition, five fleeces from randomly selected animals in each treatment were evaluated for quality characteristics including fiber diameter (ASTM, 1986; standard test method D-2130), clean yield and vegetble matter (ASTM, 1986; standard test method D-584). Fiber diameter variablility, expressed as the standard deviation of individual fiber diameters in a particular fleece, was also determined. Twelve months following the five-month clip, ewes were shorn a third time and grease fleece weights were again obtained.

All data obtained from ewe lambs were subjected to analysis of variance for completely random designs (Snedecor and Cochran, 1967). When treatment differences were observed, means were evaluated with linear and quadratic contrasts.

Results and Discussion

Body Weights and Serum GH Profiles

Ewe lamb weights obtained before treatment began (day (day 0 = first day of treatment) were similar ($P > .50$) among groups (average 100.3 pounds). Likewise, weights recorded the final day of treatment did not differ in control and GH-treated ewes (106.0, 104.2 and 108.6 pounds on day thirty for animals receiving 0, 2.5 and 5 mg oGH, respectively; $P > .10$). Furthermore, weights obtained at monthly intervals after treatment ended, as well as just before shearing, were similar ($P > .10$) among groups (table 1). These data agree with those of Muir et al. (1983), who reported no response in growth rate in wethers receiving 7 mg oGH daily for eight weeks. In contrast, other studies noted improved live-weight gains in wethers receiving 15 mg GH daily for 98 to 112 days (Wagner and Veenhuizen, 1978) and in ewe lambs treated daily with .1 mg bovine (b) GH/kg body weight for twelve weeks (Johnsson et al., 1985). Muir et al. (1983) suggested inconsistent responses to GH may result from differences in biological activity, dosage, method of administration and age of animal.

Jugular blood samples (mean ± SE) obtained before treatment revealed no differences ($P > .10$) in serum GH among groups (.4, .4 and .6 ± .2 ng/ml for ewes receiving 0, 2.5 and 5 mg oGH on day 0 of treatment). However, beginning of day 1, ewes receiving either 2.5 or 5 mg oGH had higher (linear, $P < .01$) serum GH levels. This dose-dependent increase ($P < .01$) continued throughout the thirty-day treatment period, with serum GH values on the final day of treatment of 1.5, 15.7 and 24.0 ± 3.9 ng/ml for the 0, 2.5 and 5 mg oGH groups, respectively. In samples collected during the breeding season, serum GH in GH-treated ewes decreased with time but remained higher (linear $P < .10$) throughout the thirty-four-day breeding period compared with control

ewes (1.5, 3.8 and 4.2 = .6 ng/ml for ewes receiving 0, 2.5, and 5 mg oGH, respectively, on the final day of breeding). Therefore, the treatment regimen used in this study appears to maintain serum GH above control concentrations for approximately one month following termination of treatment.

Staple Length and Grease Fleece Characteristics

Staple length measurements recorded during the five months after treatment began are shown in table 2. Staple lengths on the final day of treatment (day thirty) were comparable in control and GH-treated ewe lambs. In contrast, Wynn et al. (1979) reported a significant decrease in wool growth during the treatment period in sheep receiving 10 mg oGH/day for thirty days. However, additional data reported by Wynn (1982) suggested high dosages of exogenous GH may depress wool production during the time when treatments are imposed. No differences ($P > .10$) were detected in staple length on day 60; however, on day 90, a quadratic response ($P < .05$) to treatment was noted in the shoulder area (1.4, 1.5 and 1.4 ± .05 inches for the 0, 2.5 and 5 mg oGH groups, respectively). Staple lengths were again comparable in the three groups 120 days after treatment began. Although staple length did not appear to be affected by exogenous oGH in this study, daily injections of unfractionated pituitary extract (Ferguson, 1954), purified bGH (Fergusen et al., 1965; Reklewska, 1974) or purified oGH (Wheatley et al., 1966; Wallace, 1979; Wynn et al., 1979; Wynn, 1982) administered four to eight weeks stimulated wool growth for up to thirty weeks after treatment ended. Reklewska (1974) reported that GH affected wool growth by increasing staple length. Wallace (1979), however, reported GH changed fiber diameter rather than fiber length. Downes and Wallace (1965) also reported intradermal GH injection failed to produce an effect on fiber length. Differences among studies may be

Table 1. Animal and Grease Fleece Weights in Fine-Wool Ewe Lambs Treated with Ovine Growth Hormone (oGH)[1].

Item	oGH 0	oGH 2.5	oGH 5.0	SE
Ewe lambs, number	10	10	10	
Body weight, lb[2]	132.7	132.7	136.4	3.3
Grease fleece weight, lb[3]	6.6	6.8	6.6	.5
Grease fleece weight, % of unshorn body weight[3]	5.0	5.1	4.8	.4
Grease fleece weight, lb[4]	10.6	11.2	10.8	1.8

[1] Treatments were administered for one month before a fall breeding season and consisted of daily injections for 10 days and continued on alternate days for an additional 20 days. Row values do not differ ($P > .10$).

[2] Weights obtained just before shearing.

[3] Fleece weights obtained five months after initiation of treatment.

[4] Fleece weights obtained 17 months after initiation of treatment. Number of ewes per treatment were 7, 9 and 5 for ewes receiving 0, 2.5 and 5 mg oGH, respectively.

Table 2. Staple Length Measurements Obtained at Monthly Intervals in Fine-Wool Ewe Lambs Following Treatment with Ovine Growth Hormone (oGH)[1]

Staple length, in	oGH (mg) 0	2.5	5.0	SE
Day 30				
Location[2]				
S[3]	.6	.7	.6	.03
M[3]	.6	.7	.7	.03
H[3]	.6	.6	.6	.02
Day 60				
Location[2]				
S[3]	1.1	1.1	1.0	.05
M[3]	1.0	1.1	1.1	.04
H[3]	.8	.9	.9	.04
Day 90				
Location[2]				
S[4]	1.4	1.5	1.4	.05
M[3]	1.4	1.5	1.4	.05
H[3]	1.3	1.3	1.2	.05
Day 120				
Location[2]				
S[3]	1.8	1.8	1.8	.06
M[3]	1.7	1.7	1.7	.05
H[3]	1.6	1.7	1.6	.06

[1] Day 0 = first day of treatment. Treatments were administered for one month before a fall breeding season and consisted of daily injections for 10 days and continued on alternate days for an additional 20 days (10 ewes/treatment).

[2] Sample measurements were collected from shoulder (S), midsection (M) and hip (H) areas (over the scapulo-humeral joint , the last rib and the tuber coxae, respectively).

[3] Row means do not differ ($P > .10$)

[4] Quadratic effect of treatment ($P < .05$)

Table 3. Fleece Quality Characteristics in Fine-Wool Ewe Lambs Treated with Ovine Growth Hormone (oGH)[1,2]

Item	oGH 0	oGH 2.5	oGH 5.0	SE
Ewe lambs, number	5	5	5	
Body weight, lb[3,6]	123.0	135.5	137.1	3.1
Grease fleece weight, lb[5]	5.5	6.3	6.0	.3
Grease fleece weight, % of unshorn body weight[5]	4.5	4.6	4.4	.3
Clean fleece weight, lb[5]	3.2	3.4	3.2	.2
Clean fleece weight, % of unshorn body weight[5]	2.6	2.5	2.3	.1
Clean fleece, %[5]	57.9	54.4	53.8	1.7
Vegtable matter, %[4,5]	.42	.62	.72	.1
Average fiber diameter, um[5]	22.7	22.0	22.9	.7
Fiber diameter variability, S.D., um[5]	6.2	6.1	6.3	.3

[1] Treatments were administered for one month before a fall breeding season and consisted of daily injections for 10 days and continued on alternate days for an additional 20 days.

[2] Values collected from fleeces obtained five months following initiation of treatment.

[3] Body weights collected before day of shearing.

[4] Grease basis.

[5] Means do not differ (P>.10).

[6] Linear effect of treatment (P<.05).

related to dosage levels, length of treatment or age of animal. Length measurements recorded in the present study are reported primarily for descriptive purposes because the method of determining staple length (linear rule) was crude at best. This method was chosen to prevent fleece damage, which might influence grease and clean weight measurements.

Grease fleece weight, expressed as either raw weight or as a percentage of body weight, obtained five months after treatment began was similar (P>.10) among treatment groups (table 1). Similarly, Muir et al. (1983) reported a treatment regimen that raised plasma GH levels to more than 100 ng/ml had no effect on fleece weight in rapidly growing wethers. In contrast, an increase in grease fleece weight was noted in ewe lambs having plasma GH levels of 8 to 10 ng/ml (Muir et al., 1983). Therefore, although exogenous oGH may not enhance grease fleece weight, adverse effects on this fleece characteristic do not appear to occur. No differences (P>.10) in grease fleece weights were noted in control and GH-treated ewes twelve months after the five-month clip. Likewise, Reklewska (1974) reported comparable fleece weights among treatments eleven months after cessation of GH injections.

Wool Quality Characteristics

Fleece quality is usually measured in terms of fineness (fiber diameter), uniformity (variability) in fiber diameter and clean yield. Five randomly chosen ewes from each treatment group were used to determine these variables and data are shown in table 3. Neither grease fleece weight nor clean fleece weight differed (P>.10) between control and GH-treated ewes. Body weights obtained from the five intensively sampled ewes before shearing differed (P<.05) among groups in a linear dose-dependent manner (123.0, 135.5 and 137.1 ± 3.1 pounds for ewes receiving 0, 2.5 and 5 mg oGH, respectively). However, when grease and clean fleece weights were expressed as a percentage of unshorn body weight, fleece weights were comparable (P>.10) in GH-treated ewes and controls. Likewise, percentage vegetable matter did not differ (P>.10) among groups. As stated earlier, Wallace (1979) reported a significant increase in fiber diameter as a result of oGH treatment. However, no differences (P>.10) were detected in either fiber diameter or fiber diameter variability in the present study. Data presented in table 3 indicate, except for a tendency for increased vegetable matter in GH-treated ewes, oGH administered at 2.5 or 5 mg/day over a thirty-day period to growing ewe lambs does not alter wool quality characteristics.

With GH likely to be one of the first products of recombinant DNA technology to be commercially available to the rancher, effects of GH on wool production need to be determined. Results from this study indicate exogenous oGH administered at either 2.5 or 5 mg/day for thirty days before a fall breeding season to ewe lambs does not appear to adversely affect wool production.

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