

EFFECTS OF TESTOSTERONE ON WOOL GROWTH IN WETHERS

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Summary

Single implants of 35 mg, 70 mg and 140 mg of testosterone propionate induced significant increases in wool growth rates and significantly depressed appetite of Corriedale wethers fed *ad libitum* in pens. Under field conditions, the fleece weight of Merino wethers was significantly increased following the implantation of 70 mg of testosterone propionate in April and October and in another group implanted additionally in July and January. These increases were recorded in a flock that has no history of sheath rot and so it is concluded that the mode of action of testosterone in wethers is physiological rather than pharmacological.

I. INTRODUCTION

In a preliminary report on the effects of testosterone on wethers (Osborne and Widdows 1961), it was noted that significant increases in growth appeared to follow the implantation of testosterone propionate at levels which had been found satisfactory for the control of posthitis in the field (i.e. 70 mg in late summer, repeated in late winter). In studies on the therapeutic effects of implanted testosterone propionate (100 mg) in wethers affected with both the external preputial ulceration (EPU) and internal ulceration (sheath rot) forms of posthitis, Southcott (1962) observed increases in both wool and body growth. He conjectured that these increases could have resulted as a consequence of the better health of the treated wethers.

The experiments described here were designed to study the effects on the wool growth rate and the fleece of different dose rates and frequencies of testosterone propionate implantation into wethers in environments considered to be free from posthitis.

II. MATERIALS AND METHODS

(a) Frequency-response trial

This was part of a larger trial designed to study the effects of treatment on the components of fleece weight. Two hundred and ten medium-woolled, six-month-old Merino wethers at Dubbo, N.S.W., were randomised into three groups. Two groups were given testosterone propionate (70 mg) per subcutaneous implantation in April 1962 whilst the third group was left untreated to serve as a control. Of the treated groups, one (high frequency) received additional 70 mg

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implantations at three-monthly intervals, i.e. in July and October 1962 and January and April 1963; the other (low frequency) received additional 70 mg implantations at six-monthly intervals, i.e. in October 1962 and April 1963. All wethers were weighed and inspected for posthitis on the implantation dates. At shearing (May 1963) fleeces were weighed and samples taken for appraisal and yield determination.

The sheep were run exclusively on native pasture but hand feeding of lucerne hay was necessary in July 1962. Rain in the following month produced a flush of medics which made further hand feeding unnecessary, whilst heavy rain in January 1963 resulted in a lush grass sward quite devoid of legumes. As the property had no history of posthitis, no attempt was made to synchronise implantation with the autumn and spring flushes of feed.

(b) Dose-response trial

This was part of a larger trial comparing the effects of two steroids on wool growth rate. Thirty-two 2-tooth Corriedale wethers were allotted at random to individual pens in an animal house in May 1964. A pelleted ration of lucerne meal and wheat meal was fed *ad libitum* and daily feed intakes recorded. Appetite defined as the mean daily food intake per unit of live weight^{0.734}) was calculated for each period. Estimates of wool growth rate (defined as the weight of clean wool produced by 1 sq. decimetre of skin/day) were obtained by clipping defined mid-side patches at three-weekly intervals. Wool growth rate was measured over two pretreatment periods. The possibility of bias due to liveweight-dose effects was overcome by employing a randomised blocks design. Four sheep in each block were left untreated whilst subcutaneous implants of testosterone propionate of 17.5 mg, 35 mg, 70 mg or 140 mg were administered to the others. Two further measurements of wool growth rate were obtained following testosterone treatment. Wool growth rate and appetite were adjusted by covariance analysis with pretreatment levels as independent covariables. Analysis of variance was used to test the comparison between the adjusted means of the treated and untreated groups, as well as between doses. In the latter case, factorial coefficients

TABLE 1

Effect of testosterone propionate implantation (70 mg) on the fleece growth of Merino wethers at Dubbo, N.S.W.

	Treatment frequency		
	3-monthly	6-monthly	Nil
Clean fleece weight	3.95 ± 0.04 kg*	3.86 ± 0.06 kg*	3.69 ± 0.04 kg
Yield	69.8 ± 0.5%*	69.8 ± 0.5%*	70.9 ± 0.5%
Fleece weight index	0.896 ± 0.011**	0.943 ± 0.011 ^{n.s.}	0.819 ± 0.011

Significance of differences between treated and control:

n.s. not significant. *0.01 < P < 0.05 ** P ≤ 0.01

Sequential test of means (Hartley)

clean fleece weight: 3-monthly > 6-monthly > nil

yield: 3-monthly = 6-monthly < nil

fleece weight index: 3-monthly > 6-monthly > nil

TABLE 2

Covariance analysis Of the effects Of testosterone propionate on wool growth rate adjusted for differences in pretreatment production. Doses Of testosterone 17.5 mg, 35 mg, 70 mg and 140 mg implanted subcutaneously.

Source of variation	Deviations from regression		
	d.f.	mean square	F
Blocks	3	6.17	0.65 ^{n.s.}
Treatment vs control	1	72.36	7.69**
Linear testosterone effects	1	28.02	2.98 (P<0.1)
Residual testosterone effects	2	0.04	0.00 ^{n.s.}
Error	35	9.41	

were employed to partition the adjusted dose sum of squares into a component for linear regression and one for deviations from regression.

III. RESULTS

(a) Frequency-response trial

Treated wethers had a higher average clean fleece weight than untreated wethers, but the difference between high and low frequency treatments was not significant. Treatment also depressed yield slightly (Table 1) .

The fleece weight index (FWI = clean fleece weight ÷ mean liveweight^{2/3}) was significantly increased by high frequency treatment but not by low frequency treatment (Table 1) .

No sheath rot **was** seen, although a high incidence of EPU was found in the untreated wethers from October through to March. Incidence of EPU in treated wethers was generally less than half of that in the untreated wethers. No significant correlations between fleece weight and EPU were displayed in the testosterone propionate treated wethers whilst in the untreated wethers the presence of EPU was associated with a significantly (P < 0.05) heavier fleece: the mean fleece weight of the "diseased" segment was 0.16 kg greater than that of the "clean" segment.

(b) Dose-response trial

The between sheep coefficient of variation in wool growth rate observed during the pretreatment period was 28% . The mean wool growth rate of the

TABLE 3

Sequential test (Hartley) Of the adjusted mean wool growth rates (mg dm⁻² day⁻¹). Least significant difference for each comparison is shown in parenthesis.

Group	Adjusted	Control	17.5 mg
	Mean		
140 mg testosterone	150.6	31.1* (22.1)	19.3 ^{n.s.}
70 mg ,,	145.8	26.3* (20.6)	14.5 ^{n.s.}
35 mg ,,	139.3	19.8* (18.8)	8.0 ^{n.s.}
17.5 mg ,,	131.3	11.8 ^{n.s.} (15.5)	—
Control	119.5	—	—

TABLE 4

Covariance analysis of the effects of testosterone propionate on appetite adjusted for differences in pretreatment levels. Doses of 17.5 mg, 35 mg, 70 mg and 140 mg testosterone propionate implanted subcutaneously.

Source of variation	Deviations from regression		
	d.f.	mean square	F
Blocks	3	0.0443	1.96 ^{n.s.}
Treatment vs control	1	0.1067	4.73*
Linear testosterone effects	1	0.0464	1.98 ^{n.s.}
Residual testosterone effects	2	0.0023	0.1 ^{n.s.}
Error	35	0.0226	

testosterone propionate treated group was significantly greater ($P < 0.01$) than that of the control group. Differences between doses just failed to make significance ($P < 0.1$) although 99% of the total variance was accounted for by linear regression (Table 2).

Comparison of the several dosage groups with the control showed that only the smallest dose failed to produce a significant stimulation of wool growth rate (Table 3).

Treatment with testosterone propionate resulted in a significant depression ($0.01 < P < 0.05$) in appetite from 73.2 ± 1.3 (s.e.) $\text{g}/\text{W}^{0.734}/\text{day}$ for the control group to 70.3 ± 1.3 (s.e.) $\text{g}/\text{W}^{0.734}/\text{day}$. Differences between doses were not significant except that the appetite of the group treated at the 140 mg level was significantly ($0.01 < P < 0.05$) less than that of the group treated with 17.5 mg (Table 4). It can be seen that in this case linear regression of appetite on dose accounts for 95% of the total variance.

Incidence of EPU in both treated and control groups was low and showed no correlation with either wool growth rate or appetite.

IV. DISCUSSION

The results reported here clearly demonstrate a stimulatory effect of testosterone propionate on wool growth at doses in excess of 17.5 mg, although the evidence for a dose-response relationship is not so unequivocal. It is believed that significant differences between dosages would be shown with larger groups, or alternatively with a more uniform line of wethers. A high between sheep coefficient of variation in wool growth rate had not been anticipated as previous pen studies (Osborne, unpublished data) as well as work by Schinckel (1960) suggested that a reasonable estimate of 20% might be taken in determining the minimum number of wethers required. Although the results obtained from the dose response trial were with sheep fed *ad libitum*, increases in wool growth were obtained in the field trial with sheep which were subjected to periods of nutritional stress.

The depression of appetite following testosterone therapy was unexpected for it is generally believed that the treatment of animals with hormones will increase the energy requirement and thus indirectly alter the long term regulation of food

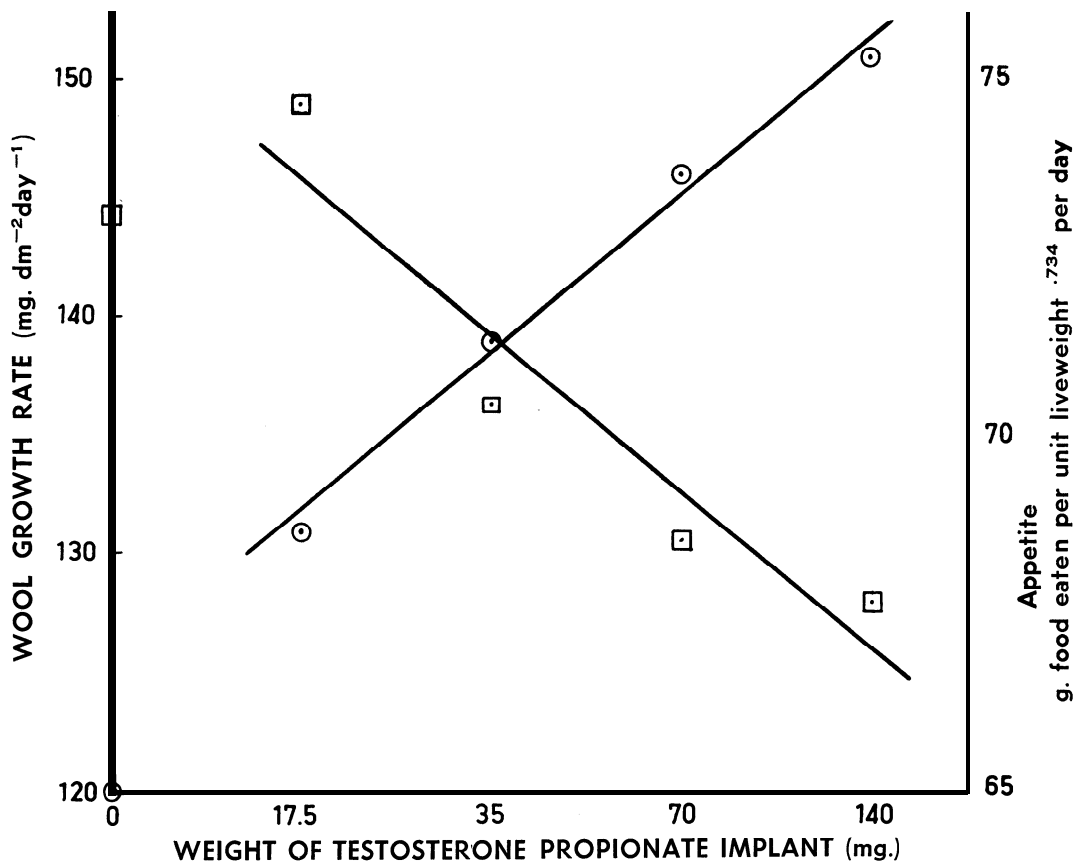


Fig. 1.—Effect of increasing dosage of testosterone propionate on the wool growth rate (○) and appetite (□) of Corriedale wethers.

intake (Anand 1961) although there seems little evidence to support this belief (Balch and Campling 1962). However, Lamming (1963) has suggested that the effect of sex hormone treatment on the endocrine system of ruminants is probably concerned with an increase in somatotrophin production and a change in the equilibrium between somatotrophin and insulin which results in changes in the blood carbohydrate level, and therefore stimulates appetite. Ferguson, Wallace and Lindner (1965) appear to be in general agreement with this as they concluded that testosterone given in physiological doses does not affect wool growth independently of effects on food intake. However, they did not elicit any evidence for an effect of testosterone on food intake. Furthermore, the doses of testosterone used in the experiments cited could be expected to produce only a trivial wool growth response under the most favourable conditions. It is apparent from the results now presented in this paper that, under conditions of adequate nutrition, testosterone will enhance wool growth and this response is independent of effects on food intake.

The use of the fleece weight index as a measure of the gross efficiency of wool growth has been discussed by Schinckel (1960) and is based on the assump-

tion that food intake is proportional to body weight. The increase in the fleece weight index of the high frequency testosterone treatment group may be interpreted as an increase in efficiency only if treatment does not increase appetite under grazing conditions. These data offer little information on this point, although they do not support an hypothesis of decreased efficiency consequent to testosterone therapy. It is to be expected that food intake of testosterone treated wethers will exceed that of untreated wethers as a consequence of the greater size of the former. It is also likely that treated wethers may have some advantage resulting from increased vigour over untreated wethers grazing the same paddock; this effect could be more pronounced in times of nutritional stress.

The observation that increases in wool growth may be induced in testosterone treated wethers in the absence of sheath rot shows that the increases are not the result of improved health, but may be due to changes in metabolism. The further observations that untreated wethers with EPU have a higher average fleece weight than healthy wethers supports this view. This observation also suggests that the EPU observed in this trial were atypical if they represented a symptom of posthitis for in endemic areas the presence of EPU is associated with a depression in fleece weight (Osborne and Widdows 1961) in affected animals.

V. ACKNOWLEDGMENTS

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VI. REFERENCES

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