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Effect of growth promotant implants on liveweight change, wool and carcass characteristics of mature wethers grazing dry season pastures

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Summary. Thirty-two mature recently shorn wethers (mean liveweight 52.1 kg) were implanted with 1 of 4 different hormonal growth promotants (Ralgro, Compudose, Revalor-S and Synovex-H) to determine animal production responses on dry season pastures. The wethers were grazed for a period of 135 days on dry season native Mitchell grass (*Astrebla* spp.) pastures infested with *Acacia nilotica*. The wethers were weighed monthly. Four months after commencement of the experiment, the wethers were shorn to determine wool characteristics (micron, yield and staple length). At 2 weeks post-shearing the wethers were slaughtered to determine carcass attributes.

Serial rumen ammonia concentrations indicated that diet quality was declining throughout the experiment. Relative to the controls, the Compudose implant had increased ($P<0.05$) average daily gain by day 29 of the experiment. At days 93 and 118 post-implantation, compared with the control wethers, Compudose and Synovex-H implantation of wethers had significantly ($P<0.05$) increased liveweight and average daily gain. Average daily gain of the control, Compudose and Synovex-H wethers to day 93 and 118 was 3, 32 and 33, and 12, 43 and 43 g/day respectively. There was no effect of Ralgro or Revalor-S on liveweight or average daily gain. There was no significant effect of hormonal growth promotant treatment on hot carcass weight, fat depth or fleece characteristics.

We conclude that under declining nutritional conditions, hormonal growth promotant treatment of mature wethers with either Compudose or Synovex-H improves liveweight performance on dry season *Astrebla* spp. pastures. The small improvement in liveweight may not provide economic returns for sheep destined for Asian export or manufacturing meat markets. An implant dose of 8 mg of oestradiol (Compudose) or a combined dose of 75 mg of testosterone and 7.5 mg of oestradiol (Synovex-H), was adequate to stimulate liveweight gain under these conditions. The effects of implantation on carcass and fleece attributes require further investigation.

Introduction

Sheep grazing the Mitchell (*Astrebla* spp.) grasslands of north-western Queensland experience a declining plane of nutrition after the wet season which is reflected in reduced productivity in terms of reduced liveweight gains and wool growth rates (Lorimer 1981). One constraint to the profitability of wool-growing enterprises in this region is the absence of viable markets for surplus or cast-for-age sheep, which are often culled in significant numbers. The retail mutton market requires carcasses of minimum designated quality (>14 kg hot carcass weight, >2 mm fat thickness over the 12th rib, <5 years old) that is often difficult to meet using Merinos grazing dry season tropical pastures. However, the potential development of sheep meat markets in Asia, and the increased demand for cheap lean meat for use in processed foods, may also see an increase in the demand for mutton with a minimum specified liveweight and fat depth.

Currently, hormonal growth promotants are not registered for use in sheep in Australia. Overseas studies have illustrated their ability to boost growth performance in sheep. Lambs treated with oestrogenic implants (such as oestradiol or Zeranol) have demonstrated higher growth rates (Slen and Connell 1958; Wilson *et al*. 1972; Singh *et al*. 1985; Mahgoub *et al*. 1988; Bass *et al*. 1989; Bachman *et al*. 1993), superior feed conversion efficiencies (Wilson *et al*. 1972; Singh *et al*. 1985) and greater carcass protein content (Wilson *et al*. 1972;

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Mahgoub *et al*. 1988; Bass *et al*. 1989) than unimplanted control animals. The effects of treatment with exogenous oestrogenic compounds on wool production appears to be variable. Earlier work conducted at 'Toorak' Research Station, Julia Creek, has shown that there were consistent positive responses (11%) for fleece weight to 4 serial Zeranol implants in weaner wethers (D. Cobon unpublished data).

Little has been reported about the effects of testosterone treatment on sheep production. From the limited number of studies conducted with young actively growing sheep, testosterone treatments have been reported to improve liveweight gain, feed conversion efficiency, greasy fleece weight and fleece quality of sheep (Osborne 1966, 1968; Southcott and Royal 1971; Singh *et al*. 1985; Galbraith and Berry 1994). Galbraith and Topps (1981) noted that the growth and carcass trait response by animals to testosterone treatment was better when it was combined with oestrogenic compounds.

Similarly, trenbolone acetate either alone or in combination with oestrogenic or androgenic hormones, has been shown to provide advantages in terms of higher growth rates and improved feed conversion efficiency (Coelho *et al*. 1981; Quirke and Sheehan 1981; Sinnett-Smith *et al*. 1983; Hynd and James 1987; Sulieman *et al*. 1988), and carcass attributes (Yasin and Galbraith 1981; Coelho *et al*. 1981; Sulieman *et al*. 1988). On lower quality diets, the liveweight response to hormonal growth promotant implantation is reduced (Hynd and James 1987; Hunter and Vercoe 1988) or weight loss is minimised (Houston *et al*. 1992; Hunter *et al*. 1993). The ability of trenbolone-based implants to reduce tissue protein breakdown and reduce nitrogen losses (Hunter and Magner 1990*a*, 1990*b*) as well as reducing maintenance energy requirements, led Hunter *et al*. (1993) to propose that implants which incorporate trenbolone acetate may have potential use in growing cattle on northern Australian dry season pastures to minimise liveweight loss.

With the exception of Sulieman *et al*. (1992), there have been few studies evaluating the potential of hormonal growth promotants to increase liveweight gain and body condition of mature sheep, and improve carcass attributes because most studies have tended to concentrate on young actively growing animals where responses are likely to be greatest (Osborne 1968; Galbraith and Topps 1981).

As the western Queensland wether flock is handled little except for shearing, which commonly occurs in the dry season, the objective of this experiment was to determine the liveweight, wool and carcass response by mature wethers to various single hormonal growth promotant implants whilst grazing dry season native tropical grassland pastures (*Astrebla* spp.) infested with the woody weed *Acacia nilotica*.

Materials and methods

Animals and treatments

In late July 1994, 40 recently shorn Peppin Merino wethers of similar age [mean ± s.e. liveweight 52.1 ± 0.30 kg, condition score 3.5 (Russel *et al*. 1969)] were allocated to 1 of 5 treatment groups on a stratified liveweight basis: control (no implant), Compudose 200 (24 mg oestradiol 17ß; Elanco), Ralgro (36 mg zeranol; Malkindrodt), Revalor-S (140 mg trenbolone acetate and 20 mg oestradiol; Roussel ACLAF) or Synovex-H (200 mg testosterone propionate and 20 mg oestradiol benzoate; Syntex). These implants were commonly available for cattle treatment. Growth promotant doses administered were 33% of the above Compudose and Ralgro (1 of 3 pellets) cattle doses and 37.5% (3 of 8 pellets) of the above Revalor-S and Synovex-H cattle dose. Dose levels were selected after a survey of the scientific literature (see references this paper) indicated that sheep received implants that ranged from 20% to full strength cattle doses. Previous work conducted at 'Toorak' Research Station (D. Cobon unpublished data) with Ralgro used 33% of the cattle dose, which was considered adequate for the wethers we were to implant. The wethers were implanted under the upper skin surface of the ear according to manufacturers' recommendations. The wethers were checked at weighing on day 29 and all implants were retained. Implant activity was expected to last at least 90–100 days.

Prior to and during the experiment the wethers were grazed as 1 group on *Astrebla* spp. (0.8 dse/ha) native pastures infested with *Acacia nilotica* (about 15 trees/ha) 50 km south of Julia Creek (20°39'S, 141°45'E). Water was supplied from a bore drain which provided unrestricted access to water. On day 118 the experimental wethers were weighed and trucked from the commercial property to nearby 'Toorak' Research Station (21°02'S, 141°48'E) for shearing on day 124.

Measurements

With the exception of day 124 when the wethers were weighed and shorn after being deprived of feed and water for 20 h, the wethers were weighed on days 0 (implantation), 29, 59, 93, 118 and 136 after being deprived of feed and water for 2 h before weighing. Body condition scores (Russel *et al*. 1969) were recorded at the time of implantation (day 0) and at the conclusion of the experiment (day 136) which was 1 day before slaughter (day 137). During the grazing period a group of 5 unimplanted wethers, surplus to trial requirements, were grazed with the trial wethers. These surplus wethers were used as monitor animals for sampling of about 100 mL of rumen liquor via the oesophagus at weighing. Rumen ammonia concentration was determined on days 29, 59 and 93. A 5 mL aliquot of rumen liquor was immediately acidified using an equal volume of 0.2 mol

Table 1. Liveweight (kg) and liveweight change (g/day) of mature Peppin Merino wethers implanted with four different growth promotants whilst grazing dry season Mitchell grass pastures

Values are means for eight wethers

Day(s) of trial	Control	Ralgro	Compudose	Revalor-S	Synovex-H	Pooled s.e.m.
			Liveweight (kg)			
Day 0	52.3	52.1	52.0	51.8	52.3	0.30
Day 29	51.0	51.1	53.2	50.8	51.8	0.63
Day 59	50.9	51.8	53.5	51.8	53.1	0.83
Day 93	52.6	53.6	55.0	52.7	55.0	0.65
Day 118	53.7	55.5	57.1	54.6	57.3	0.79
Day 124[A]	44.3	46.8	47.9	46.0	47.9	0.66
Day 136[B]	44.6	46.0	49.2	46.3	47.8	1.10
			Liveweight change (g/day)			
Day 0–29	–43	–37	41	–35	–15	22.4
Day 29–59	–2	25	21	31	44	22.4
Day 59–93	48	53	38	28	61	22.6
Day 93–118	44	74	85	75	87	23.2
Day 0–93	3	16	32	9	33	7.4
Day 0–118	12	28	43	23	43	7.1
Day 29–93	24	40	28	29	58	12.4
Day 29–118	30	50	44	42	61	7.0

[A] Post-shearing and fasted liveweight. [B] Preslaughter liveweight.

HCl/L and the ammonia concentration was determined colorimetrically (Stephenson *et al*. 1984). Mid-side wool samples were collected from the shorn fleece during classing and objective wool measurements (fibre diameter, staple length and yield) were determined by the Australian Wool Testing Laboratory. At 0800 hours (after weighing) on day 136, the wethers were trucked for 3 h for slaughter early the following day (day 137) at a commercial abattoir. Hot carcass weight and 12th rib fat depth were recorded at slaughter at the GR site (110 mm from the mid-line).

In October–April (wet season) before the start of the trial, 578.8 mm of rainfall was recorded at the trial site. No rainfall was recorded during the trial period. Generally, 80% of the mean annual rainfall of 426 mm falls in the summer wet season.

Data analysis

The data were analysed as a randomised complete block design using 2-way analysis of variance. Repeated measures analysis was carried out using ante-dependence analysis of order 1 which was performed on liveweights from day 0 to 118. Data are presented as mean ± pooled s.e. for 8 animals unless otherwise indicated.

Results

Rumen ammonia concentration

Mean rumen ammonia concentrations for the study period were 86.7 ± 12.1, 65.5 ± 11.1 and 56.8 ± 9.0 mg/L for days 29, 59 and 93 respectively.

Liveweight and liveweight change

Treatment differences ($P<0.05$) for liveweight were recorded on days 93 and 118 whereas liveweight differences for day 29 approached significance ($P = 0.075$) (Table 1). At day 93, liveweight was greater in the Ralgro, Compudose, Revalor-S and Synovex-H implant treatments by 1.0, 2.4, 0.1 and 2.4 kg, respectively, relative to the control group. By day 118, the liveweight advantage was 1.8, 3.4, 0.9 and 3.6 kg respectively. Only the Compudose and Synovex-H treatments were significantly ($P<0.05$) heavier than the control treatment for days 93 and 118, and the liveweight differences between the control, Compudose and Synovex-H treatments persisted to the 124 ($P<0.05$) and 136 ($P = 0.056$) day time points of the experiment.

Average daily gain (Table 1) over the first 29 days of the experiment for wethers implanted with Compudose was superior to the control, Ralgro and Revalor-S groups. Average daily gain to day 93 was greater ($P<0.05$) in the Synovex-H and Compudose implanted wethers compared with the control weathers. Although the average daily gain was reduced by day 118, it was still greater ($P<0.05$) in these 2 implant groups. The difference between treatments for average daily gain between days 29 and 93 or 118 approached significance ($P = 0.052$). There was no significant difference between treatments for post-shearing liveweight loss. The loss between days 118 and 124 for the control, Revalor-S, Ralgro, Compudose and Synovex-H implant treatments was 9.3,

Table 2. Carcass characteristics of mature Peppin Merino wethers implanted with four different growth promotants whilst grazing dry season Mitchell grass pastures and slaughtered 137 days after implantation

Values are means for eight wethers

Variable	Control	Ralgro	Compudose	Revalor-S	Synovex-H	Pooled s.e.m.
Liveweight (kg)[A]	44.6	46.0	49.2	46.3	47.8	1.61
Condition score	3.6	3.7	3.6	3.7	3.8	0.16
Hot carcass weight (kg)	20.4	21.0	21.3	20.4	21.0	0.72
Fat depth (mm)	2.0	2.3	2.0	1.9	2.1	0.18

[A] Unfasted liveweight on day 136, wethers slaughtered early on day 137.

8.7, 9.2, 8.5 and 9.4 kg respectively. The loss between days 118 and 136 for the control, Revalor-S, Ralgro, Compudose and Synovex-H implant treatments was 9.1, 9.5, 7.9, 8.3 and 9.5 kg respectively. Adjustment of these liveweight losses for greasy fleece weight showed no significant differences between treatments.

Overall, the repeated measures analysis indicated no significant changes in profile differences over time. However, there was some evidence (P = 0.084) of a change in profile between days 59 and 93. This corresponds with the individual analyses where there were no treatment differences at day 59 but there were differences at day 98 which persisted until day 124.

Carcass measurements

The hot carcass weight and fat depth of the wethers were unaffected by the hormonal growth promotant treatments (Table 2).

Fleece measurements

There was no significant effect of treatments on fleece weight (greasy and clean), fibre diameter, staple length or yield (Table 3). However, greasy fleece cut per kilogram liveweight indicated that there was a reduction (P<0.01) in wool production due to implantation with Ralgro and Synovex-H. These groups cut less wool per kilogram liveweight than the control group.

Discussion

The results of this experiment indicate that implanting mature wethers with Compudose or Synovex-H, while grazing dry season *Astrebla* spp. pastures infested with *Acacia nilotica*, will provide positive liveweight responses. This liveweight response occurred despite the decline in diet quality (protein content), as evidenced by serial rumen ammonia concentrations. The rumen ammonia concentration (≥50 mg/L) was, however, considered adequate for microbial protein production and the maintenance of feed intake (Satter and Slyter 1974; Elliott *et al*. 1984; Stephenson *et al*. 1984), and for liveweight gain as demonstrated by the wethers continuing to gain weight during the trial.

We cannot offer an explanation as to why some implant groups (Ralgro, Revalor-S and Synovex-H) lost weight over the first 29 days of the trial while the Compudose group gained weight, although this latter observation is consistent with the results of Wilson *et al*. (1972) and Hayden *et al*. (1992), where much of the gain in liveweight occurred within the first 40 days of implantation. The reason for the improved liveweight response of the Compudose and Synovex-H implanted groups is attributable to the alteration of the hormonal status of the animals (Borger *et al*. 1973; Olsen *et al*. 1977), which in turn affects growth and carcass

Table 3. Fleece weights and attributes of mature Peppin Merino wethers 124 days after implantation with four different growth promotants whilst grazing dry season Mitchell grass pastures

Values are means for eight wethers

Variable	Control	Ralgro	Compudose	Revalor-S	Synovex-H	Pooled s.e.m.
Greasy fleece weight (kg)	1.88	1.54	1.83	1.78	1.70	0.091
Yield (%)[A]	65.90	65.50	64.00	61.30	66.40	1.770
Clean fleece weight (kg)	1.24	1.00	1.16	1.10	1.13	0.066
Fibre diameter (μ)	23.50	22.70	21.50	22.50	23.40	0.630
Staple length (mm)	41.50	41.00	42.30	43.50	40.50	1.490
Length : diameter ratio	1.78	1.82	1.97	1.94	1.74	0.079
Greasy fleece weight/LW[B]	42.80	33.00	38.00	38.60	35.60	1.810

[A] Yield is clean fleece weight/greasy fleece weight. [B] g/kg LW, where LW is day 124 post-shearing liveweight.

composition (Galbraith and Topps 1981). Generally, implanted animals exhibit an improvement (of up to 42%) in feed conversion efficiency and nitrogen balance without a concomitant increase in feed intake (Wilson *et al*. 1972; Coelho *et al*. 1981; Yasin and Galbraith 1981; Sinnett-Smith *et al*. 1983; Bachman *et al*. 1993). The Compudose and Synovex-H implants may have been sufficient to alter hormonal balance sufficiently, thereby facilitating liveweight gain while the Ralgro and Revalor-S doses may have been inadequate to alter hormonal balance.

Average daily gain results of this study appear to indicate that an implant dose of 8 mg of oestradiol (Compudose), or a combined dose of 75 mg of testosterone and 7.5 mg of oestradiol (Synovex-H), are adequate to stimulate growth in mature sheep on dry season pastures. Sulieman *et al*. (1992) indicated that there was no liveweight change or carcass response by mature ewes to implants of up to 60 mg of trenbolone acetate, while Hunter *et al*. (1993) also reported that large doses of trenbolone acetate (≥300 mg) were required to arrest liveweight loss in steers consuming poor quality pasture. This suggests that higher doses of Revalor-S may have been required to stimulate a liveweight response in our wethers. Higher doses of Ralgro may have also been required.

The uniform post-shearing weight loss across treatments was most likely due to poor nutrition, combined with a higher energy requirement for increased post-shearing heat production (Farrell and Corbett 1970), which may have restricted a full recovery of liveweight. Sheep are often held off feed and water at shearing, but it is unlikely that dehydration could explain the decline in post-shearing liveweight that we recorded because rehydration studies have shown that after dehydration, rehydration occurs quickly (<48 h) (Wythes *et al*. 1980; Degen and Kam 1992; Houssaini-Hilali *et al*. 1994).

The lack of a wool production response to hormonal growth promotant implantation across the treatment groups may be attributed to declining nutrition throughout the experimental period. Wool production has been reported to be at its lowest on the Mitchell grasslands during the dry season (Lorimer 1981). Hynd and James (1987) also reported no wool growth response (due to high within-group variability) to trenbolone acetate or trenbolane acetate plus oestradiol implants in sheep grazing mature pastures (despite one of the implanted groups growing 24% more wool). However, the sheep in that particular study were undergoing weight loss, while for the corresponding period, the sheep in our study were gaining weight. Generally, it appears from the literature that in order to observe fleece responses to hormonal growth promotant, implantation must be accompanied by good nutritional conditions or large and/or serial doses of hormone must be administered (Slen and Connell 1958; Osborne 1966, 1968; Southcott and Royal 1971; Hynd and James 1987; D. Cobon unpublished data). It is quite likely that under conditions of improved nutrition (i.e. wet/growing season pastures), the liveweight response by the wethers to hormonal growth promotant implantation would have been greater, as has been demonstrated by southern Australian trials (Southcott and Royal 1971; Hynd and James 1987), which also has implications for improved fleece production.

We conclude that an implant dose of 8 mg of oestradiol or an implant dose of 75 mg of testosterone combined with 7.5 mg of oestradiol is sufficient to stimulate liveweight change in mature wethers grazing dry season *Astrebla* spp. pastures. However, due to the small liveweight response (1–4 kg) under these conditions this strategy may not be an economic means of improving mature wether liveweights. Future work in this field should focus on the use of these implants during periods of better pasture quality to maximise animal response, product value and economic return in terms of liveweight and fleece weight and/or the use of an alternating serial implantation schedule. An opportunity exists when a post-wet season crutching of wethers is conducted, thus potentially increasing wether weights for dry season Asian export or manufacturing meat market sales.

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