

EFFECTS OF MELATONIN IMPLANTS ON SELECTED HORMONAL PROFILES
AND WOOL GROWTH IN MERINO WETHERS

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SUMMARY

The effects of melatonin-releasing implants on wool growth and endocrine profiles were investigated in Merino wethers. Melatonin releasing implants (Regulin) were inserted subcutaneously in two groups of animals, and replaced at six weekly intervals in one of these groups; control animals received no implant. Daytime blood samples, taken at weekly intervals and consecutive hourly samples from a 25 h sampling period were analysed for melatonin (aMT), prolactin (PRL), thyroxine (T4) and tri-iodothyronine (T3) hormone levels by RIA. Wool growth was monitored by four-weekly clippings from a tattooed midside patch on each sheep; annual wool production was determined at shearing. The results confirm that continuously elevated levels of circulating aMT (i) do not inhibit nocturnal synthesis or release of endogenous aMT (Kennaway et al. 1982) but (ii) do suppress circulating PRL levels (Kennaway et al. 1982). Thyroid hormone levels, live weight, monthly patch wool growth and annual wool production all remained unaltered by acute or chronic aMT treatment.

INTRODUCTION

Melatonin-related treatments influence pelage changes in a variety of species, including arctic foxes, mink, deer and domestic animals [e.g. cashmere production in goats (Foldes and McDonald unpubl. data), and shedding cycles in Soay (Lincoln et al. 1980) and Wiltshire Horn (Williams 1981) sheep]. As part of our studies on the ovine pineal gland (Maxwell et al. 1988, 1989), we now report the effects of continuously elevated circulating aMT levels on wool growth and hormone profiles in Merino wethers.

MATERIALS AND METHODS

Animals and wool measurements

Fine wool Merino wethers (n = 35, September 1987 drop) were housed in single pens for 17 months after weaning and were offered a pelleted diet of lucerne: oaten chaff (60:40 w/w, 15.3% average protein content) and water *ad lib*. Monthly average temperatures during this period ranged from 10.5°C minimum to 27.1°C maximum. The sheep consumed 1080 g (dry weight) of the pelleted diet daily until they reached a mean live weight of about 40 kg, and were then reduced in two steps, to a maintenance consumption level of 540 g (dry weight/day). At about four months of age, each wether had a 10 x 10 cm patch tattooed onto its midside, under lignocaine local anaesthesia, and the patches were clipped at four-weekly intervals. Wool samples were treated (Maxwell et al. 1988) to determine clean conditioned wool weight (CCWW), and mean fibre diameter. Annual wool production was determined as greasy fleece weight at the time of shearing (April). The wethers were randomly allocated into three experimental groups in February 1988: untreated controls (n = 14), short (n = 6) and long term treated (n = 15). All sheep were weighed at four-weekly intervals.

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Melatonin treatments

Two aMT-releasing implants (Regulin) were inserted subcutaneously behind the right ear of each treated wether. The implants were renewed at six-weekly intervals throughout the experiment in the case of the long-term treated wethers, but were not renewed in the case of the short-term treated wethers.

Blood sampling

Weekly daytime blood samples (10 ml) were taken from all treated wethers by venipuncture for the first eight weeks, and from the 15 long-term treated wethers for the entire duration of the experiment. In October 1988, blood samples (10 ml) were taken at hourly intervals for 25 h from six wethers (randomly selected where appropriate) from each treatment group. Blood was sampled via indwelling catheters, inserted into the left jugular vein under lignocaine local anaesthesia. During the hours of darkness, the sheep were exposed to dim red light only. Plasma samples were stored at -20°C prior to analysis.

Hormone analysis

Circulating levels of aMT, PRL, T3 and T4 were determined by radioimmunoassays. Previously described methods (Maxwell *et al.* 1989) were used to determine aMT and PRL levels; thyroid hormones were analysed by the method of Wallace *et al.* (1978).

Statistical methods

Differences in mean wool parameters and hormone profiles over time were compared using a repeated measures ANOVA.

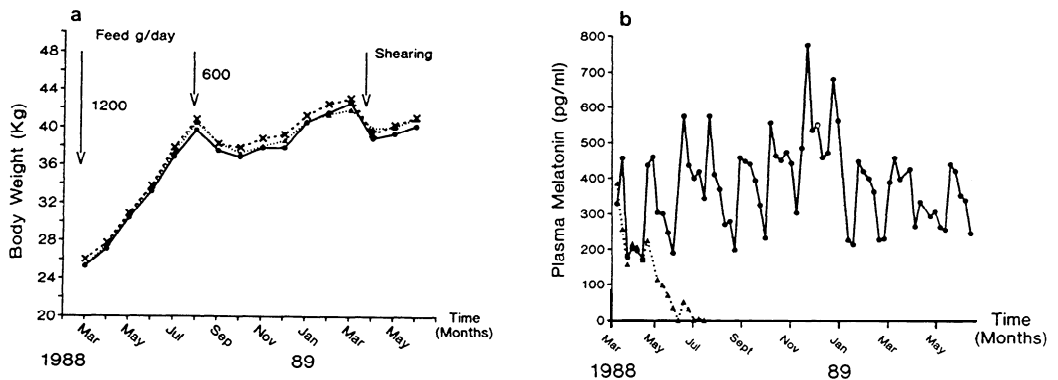


Fig. 1. (a) Group mean live weights at four-weekly intervals. (b) Plasma melatonin profile - daytime levels. In the long-term treatment group, new implants were inserted subcutaneously at six-weekly intervals. No detectable aMT was present in untreated control wethers. (x---x) control wethers, (●---●) long-term treatment, (▲...▲) short term treatment.

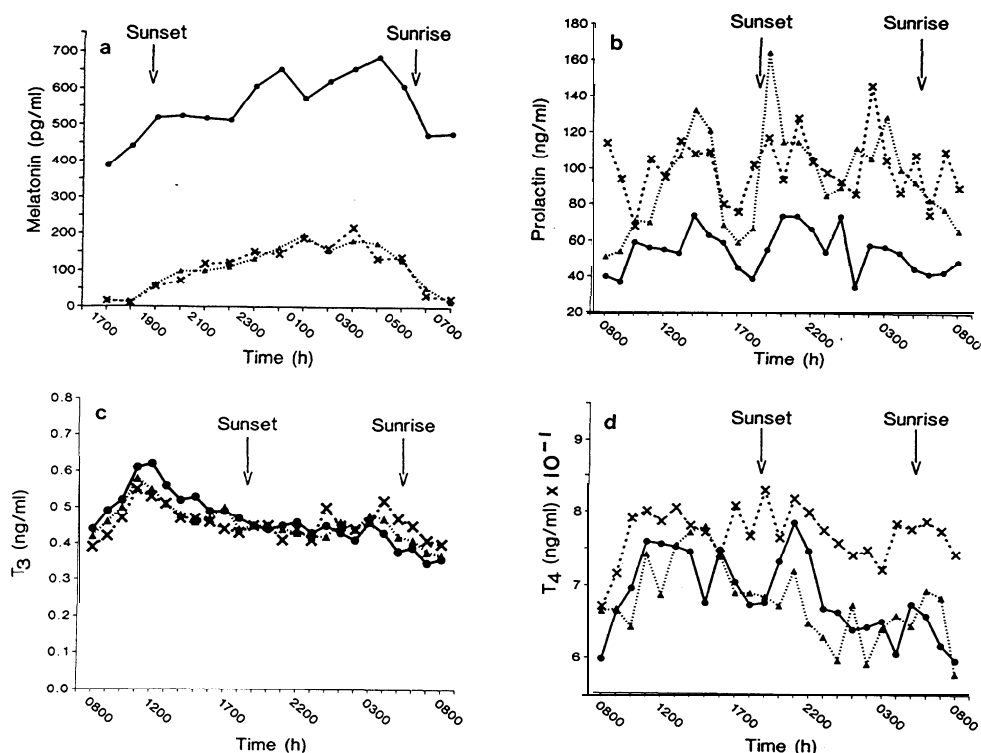


Fig. 2. (a) Group mean nocturnal melatonin levels. Average s.e.m. for the long term group is 130 pg/ml; for the other 2 groups 25 pg/ml. (b) Group mean plasma prolactin levels. Average s.e.m. for the 3 groups 17 ng/ml. (c) Group mean plasma T_3 levels. Average s.e.m. for the 3 groups < 0.1 ng/ml. (d) Group mean plasma T_4 levels. Average s.e.m. for the 3 groups 6.4 ng/ml. Symbols as in Fig. 1.

RESULTS AND DISCUSSION

The three treatment groups did not differ significantly in mean live weight throughout the experiment (Fig. 1a). Daytime plasma aMT levels were undetectable in untreated wethers and were continuously maintained in the long term implanted group above the nocturnal levels exhibited by controls. Similarly high aMT levels in the single dose group decreased to near zero by eight weeks after treatment (Fig. 1b). Nocturnal aMT levels increased over the respective daytime levels in all treatment groups (Fig. 2a); the magnitude of this increase was not significantly different in long term treated, short term treated or untreated control groups (areas under the peaks 157 ± 37 , 133 ± 34 and 129 ± 31 pg/ml/h respectively). Circulating PRL levels over the 25 h period were not different ($P > 0.05$) between control and short term treated wethers, but were lower than control levels in long-term treated wethers ($P < 0.05$, Fig. 2b). No effects of either implant treatment were noted on plasma T_3 levels ($P > 0.05$, Fig. 2c), or T_4 levels ($P > 0.05$, Fig. 2d).

Wool growth varied significantly ($P < 0.05$) with time over the 17 months of the experiment. Subcutaneous aMT treatment did not influence wool growth; neither CCWW ($P > 0.05$, Fig. 3a) nor fibre diameter ($P > 0.05$, Fig. 3b) differed significantly between the three treatment groups. This lack of effect was also reflected in annual greasy fleece weights. Mean fleece weights in the long-term treated, short-term treated and control groups were 3.8 ± 0.2 , 3.9 ± 0.2 and 3.9 ± 0.1 kg respectively.

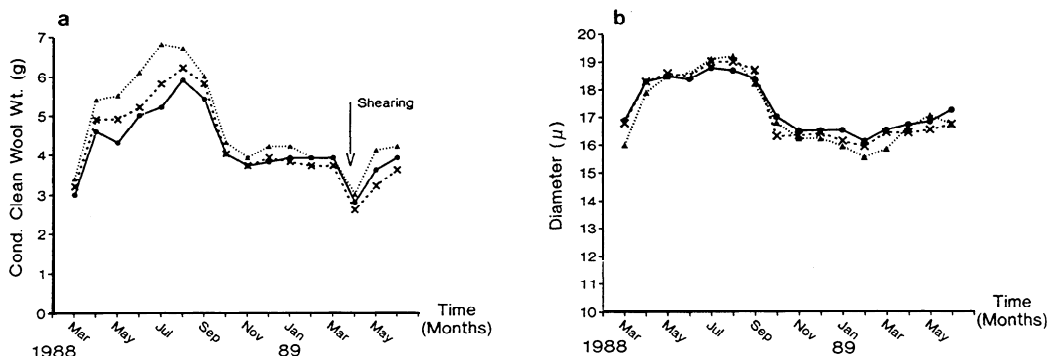


Fig. 3. (a) Group mean conditioned clean wool weight (four-weekly intervals), Average s.e.m. of the 3 groups is 0.24 g. (b) Corresponding group mean fibre diameters, Average s.e.m. for the 3 groups is 0.36 μ m. Symbols as in Fig. 1.

Our results confirm that elevated aMT levels (i) do not inhibit nocturnal synthesis or release of endogenous aMT (ii) suppress circulating PRL levels, (Kennaway et al. 1982) (iii) have no significant effect on plasma T_3 or T_4 levels. The results additionally show no effect of acutely or chronically elevated circulating aMT on wool growth parameters in fine wool Merino wethers, despite the known effect of aMT supplementation in more seasonal fibre producing species. These results suggest that use of melatonin-releasing implants for reproductive synchronization of sheep may not affect wool production; other physiological effects following from the observed endocrine changes require further investigation.

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